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★ Dr. JOHN S. BILLINGS.

CARL ZEISS · JENA

MICROSCOPES AND MICROSCOPICAL ACCESSORIES

33RD EDITION

1906

M. 184. II. 06. 4000 e.

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313272
ASTOR, LENOX AND TILDEN FOUNDATIONS.
1906

Besides this catalogue the following publications (in English, French or German) may be had gratis on application:

Micro-photographic Apparatus** for **visible** and also for **ultra-violet light,

Projection Apparatus, Episcope, Epidiascope,

Appliances** for the investigation of **Ultra-microscopical Particles,

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All the items specified in this Catalogue are supplied singly or in any desired combination at the prices quoted.

The price of the Stand includes that of the Stand proper with its cabinet or case but without Oculars, Objectives and Nose-piece. Suitable outfits are compiled at the end of the Catalogue.

The price of a Microscope with its equipment is in all cases obtained by adding together the prices of the individual items.

Our **quotations** are strictly Net Cash and do not include the cost of packing and carriage from Jena. Payment may be made by Cash, Cheques or short negotiable English, French or German Bills of Exchange. **Receipt of price and consignment of goods in Jena are held to conclude a transaction.**

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Goods are forwarded, value declared, at the risk and cost of the consignee. In the absence of special instructions, goods ordered from abroad are despatched by the most convenient routes, every precaution being taken to ensure safe and prompt delivery.

We request that the name and address may be plainly written on all orders and, to avoid misunderstanding, that the number, or year of publication, of this edition of our catalogue be quoted.

In telegraphic orders it is sufficient to quote the codeword. In cases where several specimens of the same apparatus are required it is advisable to indicate the quantity desired in words instead of in figures.

Jena, 1906. **Carl Zeiss.**

Telegraphic Address: ***Zeisswerk Jena.***

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Preface.

The present 33rd Edition of our Catalogue relating to Microscopes and Microscopical Accessories exhibits some modifications as compared with the 32nd Edition, which appeared in 1902, occasioned, mainly, by the introduction of several new forms of Stands. The construction of Stands **III** and **IV**$_{a}^{b}$— regarding whose arrangements we have already given full particulars in special prospectuses — has resulted in conferring certain advantages, rendered possible by limiting the number of the types, and by greater simplification in the mechanical equipment. Further, we have manufactured quite a simple Stand for laboratory use, more in accordance with present requirements of microscopical technic than our earlier small Stands. A detailed prospectus relating to this new Stand **V** has already been published.

In the majority of the achromatic objectives, owing to progress continually being made in division of labour with the manufacture of these systems, we are enabled thereby to effect important reductions in price. For details we would refer to the accompanying circular.

The list of the Magnifiers, the Dissecting Stands and Lens-Holders has been omitted in the present edition, since a special price list containing them will appear shortly.

The general price list appended to the last edition is in the present omitted, the entry of the prices against each item being considered as sufficient.

New apparatus or changes in construction appearing for the first time in this Catalogue are as follows:

Stand **III**, pp. 48, 49; Stand **III** M, pp. 50, 51; Stand **IV**, pp. 52, 53; Stand **V**, pp. 45, 55; Corneal Microscope with GULLSTRAND's Appliance for lateral illumination, p. 65; Stand **XI** (monocular image-erecting prism Microscope), pp. 66, 67; Micro-spectro-photometer with grating, p. 88.

The two important new constructions in the sphere of microscopy, Appliances for the investigation of Ultra-microscopical Particles by SIEDENTOPF and ZSIGMONDY and the Micro-photographical Appliances for Ultra-violet Light by KÖHLER are not included in the present Catalogue. Regarding this apparatus we must refer to the detailed descriptions and price lists published by us during the course of the past year.

Objectives and Oculars.

The Glass Works of SCHOTT & GENOSSEN, which make a specialit glasses for optical and other scientific purposes as the outcome of exhaustive periments, with our co-operation, extended over several years and carried ou SCHOTT and ABBE, succeeded in 1884 in producing a series of new glas possessing certain refractive and dispersive properties which render them r valuable for the construction of microscope lenses than the crown and flint gl superseded by them.

The use of these glasses, combined with the application of entirely n formulae, has enabled us, since 1886, to produce microscope objecti with markedly superior correction of both chromatic and sph cal aberration and, consequently, effecting a much greater con cen tion of light in the image than had previously been attainable. We introd simultaneously oculars specially adapted for use with these objectives which, b facilitating certain other advantages of minor importance, produce almost p fect achromatism and yield a sharp image over the whole a of the visual field.

By a special catalogue published in August 1886 these new combina were first made known under the designations of "Apochromatic Objectiv "Compensating Oculars" and "Projection Oculars" respectively; and have since been most extensively adopted, have met with general approba and have given most ample proof of the exceptional value of their utility in field of scientific research.

Side by side with the new objectives and oculars we continue to su our older achromatic objectives with their accompanying ordinary oc For, although in the more difficult branches of microscopical research the

chromatic objectives are to an increasing extent supplanting the older objectives, yet there are a great many problems in microscopy that do not demand the highest attainable degree of optical perfection, and in the majority of such cases the older "achromatic" microscope will render as good and sufficient service as ever, provided the instrument be good of its kind, i. e., skilfully and carefully made. The objectives and oculars of the older type have certainly this advantage that, thanks to their much simpler construction, really good lenses of this class can be supplied at prices considerably lower than those of the lenses of the new series, which are much more complicated and involve in their production an extraordinary degree of manual skill.

We should not omit to mention that all advantages derived from the introduction of new glasses and of the fluorites, and the adoption of improved formulae have been applied equally to the objectives of the older type. The improvements thus effected are of considerable importance, especially in the higher powers of the dry and immersion series, which may therefore, after the example of other makers of similar constructions, appropriately be termed "Semi-apochromatic objectives", or to part, also "Fluorite Systems".

To the two types of objectives just mentioned there has been added recently yet a third, computed by VON ROHR: the type of the Monochromats. The special features of this system are: a very perfect union of rays (spherical correction) for light rays of a definite wave-length chosen at will, the lack of a correction of chromatic aberration and the composition of the system from uncemented single lenses, which are all formed out of the same material. Since there is no chromatic correction at all, this system can only be employed in illumination with strictly monochromatic light.

Such objectives are manufactured for the present only for the Micro-photographic Appliances for Ultra-violet Light, spoken of in the preface. since the monochromatic light employed makes objectives of this correction appear suitable. They are corrected for a wave-length 275 μμ, all lenses consisting of molten quartz. We also supply a series of oculars, specially for use with these Monochromats for ultra-violet light whose lenses are made from quartz crystals.

Since 1868 all our manufacturing processes follow the system introduced into our works by Professor ABBE, a system which is based upon complete theoretical computation of all the constructive data previous to actual manufacture. By this method it has become possible, through judicious division of labour in the various stages of manufacture under competent scientific supervision, to employ a large number of operatives in the production of lenses of the greatest possible perfection.

The necessity of empirical tests has been entirely obviated by precise mathematical computation of every detail of construction combined with exact technical methods and systematic control of each phase of manufacture. This ensures an

extraordinary degree of uniformity in the highest as well as in the lowest powers of our lenses, whilst excluding the bare possibility of inferior productions. All objectives are uniformly free from spherical aberrations up to the marginal zone (assuming correct thickness of the cover-glass with the higher powers) and, as far as possible, from chromatic aberrations also. Special consideration is also given to the compensation of the aberrations in the extra-axial part of the field and to the flatness of the image.

Free working distance. Owing to the importance of a good working distance for the convenient and safe employment of the higher powers particular attention has been given to this factor in calculating the formulae of the various glasses. Our high power objectives possess therefore unusually large working distances in comparison to their focal length and aperture (see Tables on pp. 15, 22 and 26).

Tube-length. The objectives specified in this catalogue, so long as they are supplied in the ordinary mount, are all adjusted for a tube-length of 160 mm (about $6^1/_2$ in.), reckoned from the shoulder of the objective screw to the upper end of the draw-tube on which the ocular rests. In Fig. 1, this length is indicated by **T.**

The tube-length may be read off on the larger stands of our make by the divisions on the draw-tube. The interposition of any apparatus, such as a revolving nose-piece, a sliding objective-changer, &c., between the tube and the objective necessitates the shortening of the tube by the length of such intermediate piece so as to make the whole distance between objective shoulder and ocular equal to 160 mm (or about $6^1/_2$ inches).

The position of the ocular is usually somewhat higher in the case of various oculars of special construction, such as micrometer, screw micrometer, spectroscopic oculars, &c. When using such oculars this must therefore be allowed for, objective-changers, &c., being, if necessary, omitted in order to maintain the correct tube-length.

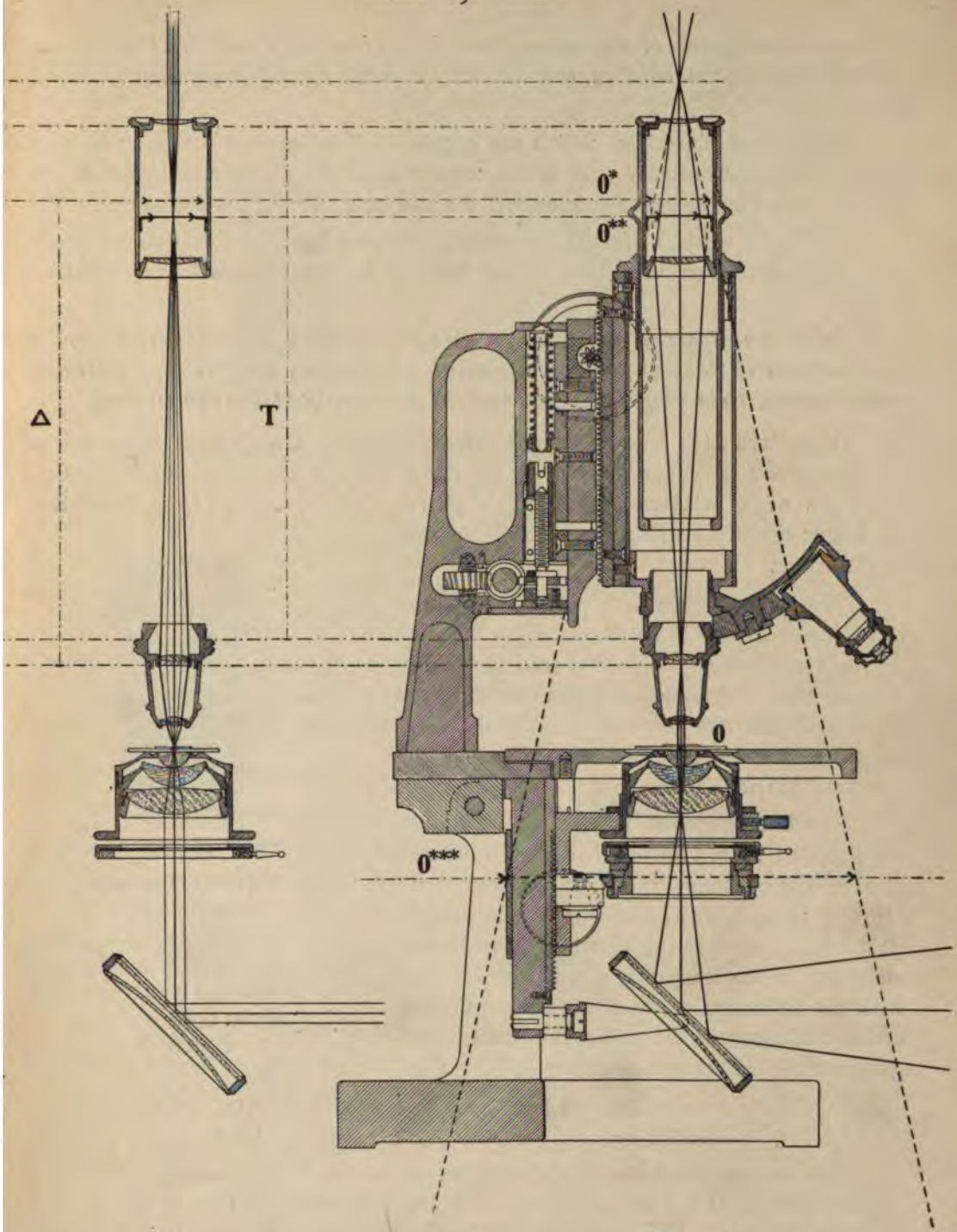
The lower-power achromatic objectives as far as **C** may also without appreciable loss, be used on English stands with 10-inch tubes.

All the other objectives, particulary those of the apochromatic series, perform more or less imperfectly on stands of the English type, unless specially adjusted.

If the objectives are to be used with tubes differing from the usual length, this fact should be expressly noted in the orders.

Thickness of cover-glass. All objectives in fixed mounts are, unless otherwise ordered, corrected for a medium thickness of cover-glass, between 0.15 and 0.20 mm.

In the higher powers (from the apochromatic objective **8 mm** *and the achromatic* **D** *upwards), with the exception of the homogeneous immersion ob-*



A B

164

Fig. 1.

A: Diagram of the path of the rays for the representation of an object point lying in the front focal plane of the whole microscope.

B: Section through Stand **III**, together with the diagram of the path of the rays for the limitation of the field of view.

F_1': hinder focal plane of the Objective **AA**; F_2: front focal plane of the HUYGENIAN Ocular 2; F': hinder focal plane of the whole Microscope; T: effective Tube-length; Δ: optical Tube-length.

$^1/_2$ Full Size.

Carl Zeiss, Jena.

jectives, that the thickness of the cover-glass which gives the most perfect correction is indicated on the side of the mount by small figures representing millimetres.

With those objectives, which we supply in fixed mounts only, it is, as a rule, sufficient for ordinary work to use cover-glasses of an estimated thickness, but for very exacting tasks we recommend the use of a cover-glass gauge (see p. 79).

A simple method of fairly accurately determining the thickness of cover-glass requisite when using one of our large or medium stands is explained on p. 42.

If it be desired that an objective should be adjusted for a cover-glass differing from the usual thickness, or for use without cover-glass, this requirement should be specified in the order.

Objectives with correction adjustment. Fig. 2. The divisions and numbers on the correction collar (*bb*), read off by a fixed index, indicate (in hundredths of a millimetre) that thickness of cover-glass which gives the best correction corresponding to the position of the collar.

The correction for cover-glass thickness must always be carefully adjusted — particularly in the case of the apochromatic objectives **6 mm, 4 mm, 3 mm** (dry) and **2.5 mm** (water immersion) — otherwise the efficiency of the lenses will be greatly impaired.

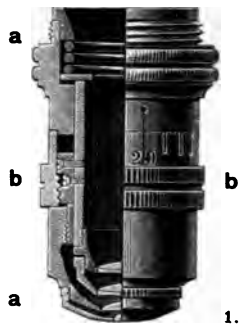


Fig. 2.

Objective fitted with correction-collar.

The correction-ring bb serves to adjust the distance between the two upper double lenses and the two lower lenses attached to the mount aa.

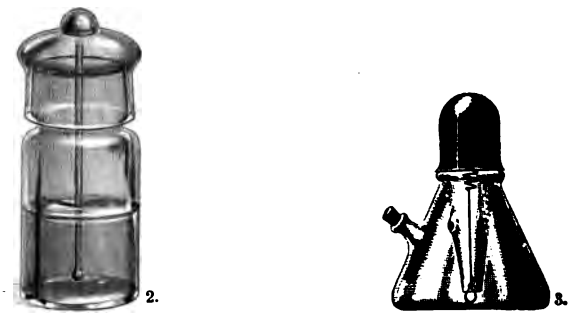
(Full Size.)

The **homogeneous immersion objectives** are supplied in fixed mounts only, since their efficiency, within rather wide limits, is independent of the thickness of the cover-glass, and also because any alteration in the lens distances would interfere with the perfection of their correction. Considerable variations in the thickness of the cover-glasses are best compensated for

by slightly *lengthening* the body-tube in exceedingly *thin* cover-glasses,
„ „ *shortening* „ „ „ „ excessively *thick* „ „ .

The **immersion fluid** which we recommend for homogeneous objectives is slightly thickened Cedar-wood Oil (from Juniperus virginiana) as used by us from the first. We expressly desire to caution against the use of immersion fluids derived from other sources, with our objectives, as the use of fluids of irregular refractive and dispersive power may entail considerable impairment of the optical performances of the objectives.

Each time after use the objectives should be made scrupulously clean. The oil adhering should be soaked up with linen or blotting paper, and then the front lens together with its mount should be most carefully wiped dry with a piece of very soft linen moistened by a drop of benzine or xylol.



a b

Fig. 3. Cap-bottle for Immersion oil No. 2005 and 2010. (1/2 Full Size.)

The two little bottles shown in Figs. 3a and 3b afford comfort and convenience in using the immersion oil. The cap and rod of the bottle, No. 2005, are made of glass, those of the No. 2010, which we originally made on specifications supplied by Dr. L. MACH (see "Zeitschr. f. Mikrosk.", Vol. XIV, 1897, pp. 348—350), consist of metal.

With each homogeneous immersion objective of our own make we supply gratis one of MACH's bottles with a separate flask containing about 15 gr. of Cedar-wood Oil.

For prices, ordered independently, see below.

The expression **"Numerical Aperture"**, or "Aperture" simply, was introduced in 1873 by Professor ABBE on the basis of his own theoretical investigations. The value of the numerical aperture is determined by the equation:

$$num.\ Ap. = n.\ sin\ u,$$

n being equal to the refractive index of the medium situated between the cover-glass and the front lens of the objective, u representing half the angle of aperture.

The numerical aperture of a lens determines all its essential qualities: the **brightness of the image** increases with a given magnification, other things being equal, in proportion to the square of the aperture; the **resolving** and **defining powers** are directly proportional to it; the **power of differentiating depth** (the **focal depth**) is, for the same object medium, proportional to the cotangent of half the angle of aperture. (For references, see ABBE, Gesammelte

	Marks	*Code-word*
Bottle for Immersion oil with glass cap and rod . . .	1.—	**Pabellon**
„ „ „ MACH's pattern	1.50	**Pabulo**
Cedar-wood Oil 15 grms, in ordinary bottle	—.75	**Pacernica**

Abhandlungen I, Jena 1904, pp. 267, 354, 365, 366, and CZAPSKI, Theorie der optischen Instrumente, 2nd Edition, Leipzig 1904, pp. 245, 254.)

The mounts of all objectives for monocular observation are provided with the **English standard screw** of about 20 mm (3/4 in.) external diameter.

The name of our firm is engraved on the mounts of all our objectives; on the apochromatic objectives are further engraved the aperture, focal length and tube-length for which they are adjusted, and on the achromatic lenses their distinguishing letters.

When ordering objectives and oculars which are intended for use with stands not made by us, it is advisable to send us the tube in question for adaptation.

*Apochromatic Objectives.

We cannot here do more than briefly describe the essential features of the apochromatic objectives and must refer those who wish to make a more complete study of the scientific aims and principles which govern the construction of these lenses, to the paper of Professor ABBE, entitled "Über Verbesserungen des Mikroskops mit Hilfe neuer Arten optischen Glases" (Sitzungsberichte der Med.-naturwissensch. Gesellschaft zu Jena, 1886, Vol. XX, pp. 107—125, ABBE, "Gesammelte Abhandlungen" I, pp. 450—472), and to Dr. CZAPSKI's work on the "Theorie der optischen Instrumente", Breslau 1893, 2nd Edition, Leipzig 1904.

The peculiar characteristic which, from the optical point of view, distinguishes the objectives of this series from all lens systems previously applied to microscopes lies in the simultaneous realisation of two conditions of concentration of rays, which conditions had hitherto not been fulfilled by any other optical system, viz: 1) the union of three different colours of the spectrum in one point of the axis, that is to say, the elimination of the secondary spectrum left uncorrected in the older achromatic lenses, and 2) the correction of the spherical aberration for two different colours, in contradistinction to the usual correction for one colour, that in the brightest region of the spectrum, only.

With all optical systems constructed up to 1886 the greatest sharpness of the image was limited to one particular colour of the light transmitted, while the other rays give more or less confused images, appearing partly as colour fringes surrounding the sharpest image and partly as a general haze spread over the whole field. But with the apochromatic lenses the images are for all colours of the spectrum nearly

equally sharp. The quality of the image will therefore be always uniformly perfect whether white or monochromatic light be employed for illumination.

Again, in the older series complete colour correction is obtained for one zone of the objective only, a marked deterioration being observable towards the margin and the centre of the aperture, whilst in the apochromatic lenses uniformly perfect colour correction is obtained for all zones alike. Consequently, in using ABBE's test plate for instance, scarcely any more colour is perceived with extreme oblique illumination than with semi-lateral or with central light.

Finally, with the ordinary achromatic objectives, even within the zone of their most complete colour correction, only two colours at a time can be united in one point and only for this pair of colours can the images fall on the same spot, considerable focal difference remaining for all others. But, as already mentioned, three colours are brought to a focus in the apochromatic objectives, whereby the focal differences of the various sections of the spectrum are reduced to fractions varying from $^1/_7$ to $^1/_{10}$ of their original magnitude, i. e., are practically eliminated, and this, we will repeat, is done in equal degree for all zones of the objective. The images due to different colours, each one individually corrected, are thus rendered perfectly coincident and collectively form the final image[1]).

The practical advantages of these new objectives are obvious. Their considerably increased power of concentrating the light with ordinary visual observation or with any other mode of application — and this under all possible conditions of illumination, central or oblique, white or monochromatic — establishes their acknowledged superiority over all earlier constructions, both with respect to optical power and diversity of applicability.

The natural colours of objects, even delicate differences of tint, are faithfully reproduced by these objectives. The images are nearly as sharp close to the margin of the field as they are in the centre.

It is true that, owing to their large aperture and comparatively great working distance, even in these objectives a slight curvature of the image cannot be entirely avoided. Therefore the marginal and central portions of the field do not appear sharply in focus simultaneously, but have to be focussed in succession by means of the micrometer screw.

As a result of their great light-gathering power these objectives admit of the use of oculars of very high power, while still retaining satisfactory precision and brightness of the image and thus giving high magnifying powers

---

[1]) Achromatisation of a higher order in our sense of the term is both theoretically and practically quite another thing than a mere improvement, in degree, of ordinary achromatism, such as would result from a diminution of the secondary spectrum while yet only two colours are united; or than achromatisation embodying the principles here indicated but limited to one particular zone of the objective, as would, for instance, be the case if suitable glasses were introduced in constructions of ordinary type. — Professor ABBE has introduced the word "apochromatic" as a definite technical term for this particular kind of achromatism, so long familiar to scientists as a theoretical idea but only recently realised practically. In order to avoid ambiguity it is desirable that this expression should retain its original meaning as clearly defined by its author, and any attempt to utilise it for purposes of trade advertisement of any other casual improvement in colour correction should be discountenanced.

with relatively great focal lengths and yielding, with the one objective, an extensive series of magnifications.

The list of apochromatic objectives on page 15 specifies in addition to particulars of the numerical aperture and foci also the corresponding initial magnification, i. e., the magnification which the objective alone would give at the distance of distinct vision if used as a single lens. This is simply 250 (distance of distinct vision in millimetres) divided by the focal length of the objective (also given in millimetres). For instance, the initial magnification of a 3 mm objective is:

$$\frac{250}{3} = 83.3$$

The numerical apertures indicated in the table are the guaranteed minimum values.

Durability of the new Glasses.

In reply to numerous enquiries and, in some cases, publicly expressed doubts we would here state that the kinds of glass used by us since 1895 in the construction of apochromatic lenses, and in a limited degree for the higher powers of achromatic objectives also, have now been so amply tested as to offer an absolute guarantee for their permanency.

In all cases where one of the lenses of an objective supplied by us should exhibit spontaneous changes, we shall continue, in the future (as we have done in the past), to repair such objectives at our own cost, substituting a new lens made of glass which has been thoroughly tested and proved to be permanent

To this promise we attach, however, the condition that the objective in question be sent to us without previous meddling by others — such as dismounting with a view to cleaning — since any interference, by inexperienced hands, tends in many cases to convert a slight irregularity, easily rectified by us, into a serious, or even irreparable, defect.

We should also point out that owing to the hyper-hemispherical form of the front lens, which is held in position by a very narrow ridge at the extreme edge of the setting, the apochromatic homogeneous immersion objectives of **2 mm** and **3 mm** focus and **1.40** num. Ap. demand very careful treatment. Even a slight jar by contact with the object may loosen this lens in its mount.

List of the Apochromatic Objectives.

	Description		Initial Magnification	Combined with Compens. Ocular 4, Tube-length 160 mm (about $6^1/_2$ in.)		Prices	Codeword
	Equivalent Focus mm	Numerical Aperture		Free Working Distance mm	Diameter of visible area of object mm	*Marks*	
Dry Series	**16**	**0.30**	15.5	5	2	**80.—**	**Pacato**
	8	**0.65**	31	1.0	1	**100.—**	**Pacetor**
	4	**0.95**	63	0.2	0.45	**140.—**	**Pacer**
	3	**0.95**	83	0.15	0.35	**160.—**	**Paciencia**
Water-Immersion	**2.5**	**1.25**	100	0.18	0.25	**250.—**	**Paciflcar**
Homogeneous Immersion	**3**	**1.30**	83	0.20	0.35	**300.—**	**Pactar**
	3	**1.40**	83	0.16	0.35	**400.—**	**Padilla**
	2	**1.30**	125	0.16	0.25	**300.—**	**Padrastro**
	2	**1.40**	125	0.12	0.25	**400.—**	**Padre**
	1.5	**1.30**	167	0.09	0.20	**350.—**	**Padrino**

Beside the objectives enumerated in this list the following apochromatic objectives are made to order and adjusted exclusively for the 10-inch tube:

12 mm, **0.65** num. Ap. . . . . Price: Mk. **140.—**. Code-word: **Paflon.**
6 mm, **0.95** num. Ap. . . . . „ „ **180.—**. „ **Paganismo.**

The three **6 mm, 4 mm, 3 mm,** *objectives of the dry series and the* **2.5 mm** *water immersion objective are supplied with correction-collars.*

Regarding the Apochromat 2 mm, num. Ap. 1.30, with fixed stop for dark-ground illumination for Investigation of Ultra-microscopical Particles, see Prospectuses M 163 and M 164.

As to the kind of immersion fluid to be used with homogeneous immersion objectives see pp. 10 and 11.

By **"Free working distance"** as specified in the foregoing table is to be understood the distance between the upper surface of a cover-glass 0.17 mm thick and the lower surface of the lens mount, the lens being sharply focussed for an object situated immediately below the cover-glass. As this quantity depends upon the metal mount of the front lens, it is necessarily subject to unavoidable slight variations, and the values given in the table are, therefore, only approximate.

The **diameter of the visible area of the object** is governed by the size of the diaphragm of the ocular. The table specifies in millimetres the visible circular area of the object in the case of each combination of component objectives and oculars. These values, too, are slightly fluctuating, as minor variations in the diameter of the diaphragm are also inevitable.

*Compensating Oculars.

All objectives of considerable aperture, from their peculiar construction (hemispherical front lens), exhibit certain colour defects in the extra-axial portion of the visual field (chromatic difference of magnification, see DIPPEL, "Das Mikroskop", 2nd Edition, Brunswick 1882, pp. 225—227; CZAPSKI, "Theorie der optischen Instrumente", 2nd Edition, Leipzig 1904, pp. 182, 368). The differently coloured elementary images which combine to form the final image are of different magnitudes, the blue being larger than the red. Whether an image be projected by such an objective without oculars, or whether it be examined with one of the ordinary oculars, colour fringes will be observed, increasing towards the margin of the field.

This peculiarity is shared by the apochromatic objectives also, and to their lower powers it has even been intentionally imparted to an approximately similar degree, a means being thereby obtained of almost entirely eliminating this error with the aid of suitable oculars. For this purpose the latter are made to possess an equivalent error of the opposite sign, that is, the image formed be the red rays is larger than that corresponding to the blue rays. Such oculars serve thus to compensate the errors of the objectives and the images then appear uniformly free from colour up to the very edge of the diaphragm prescribing the limits of the visual field, whilst this **edge of the diaphragm** itself shows a **reddish** or **yellowish** border.

The **mounts of the oculars** are adjusted so that the lower focal points of all the numbers lie in the same plane when they are inserted into the body-tube (Fig. 4).

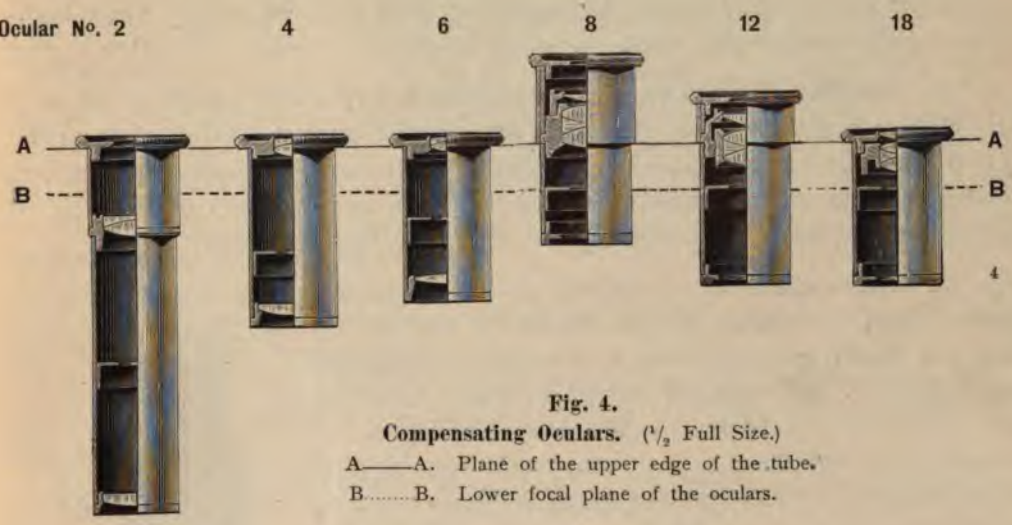


Fig. 4.
Compensating Oculars. ($^1/_2$ Full Size.)
A——A. Plane of the upper edge of the tube.
B.....B. Lower focal plane of the oculars.

A change of oculars necessitates therefore scarcely any alteration of focus, the distance between the upper focal point of the objective and the lower focal point of the ocular remaining constant. This distance, which is the determining element of the total magnifying power, is designated "the optical tube-length", and is designated by Δ in Fig. 1, p. 9, (see above-quoted work by DIPPEL, p. 188).

In continental microscopes with apochromatic objectives and compensating oculars this optical tube-length is 180 mm (about $7^1/_{16}$ in.), irrespective of small differences between various objectives, the tube-length proper (see p. 8) being in all cases maintained at 160 mm (about $6^1/_2$ in.).

The **classification of these oculars** is carried out on the plan proposed by ABBE. Accordingly, the numbers, which denote how many times an ocular — when used with the standard tube-length — increases the initial magnifying power of an objective, afford a correct measure of the ocular magnifications and, at the same time, furnish the figures for a rational series of distinguishing numbers. In this way the series of our compensating oculars has been arranged by the ocular magnifications 2, 4, 6, 8, 12, 18, which supply, at the same time, the distinguishing numbers.

The magnification at an image distance of 250 mm (10 in.) obtained by the combination of a compensating ocular with any apochromatic objective may thus be quickly found by multiplying its number by the numerical value of the initial magnification of the objective. For instance, an objective of 3 mm focus combined with ocular 12 gives a magnification of $12 \times 83.3 = 1000$ diameters.

The exceptionally low power ocular **2**, known as the **Searcher Ocular**, serves to extend the effectiveness of the various magnifications required to be successively used with any one objective as far as possible downwards through the lower strata of a specimen, also to facilitate preliminary examination and the process of searching for particular points of the object when high-power objectives are being used.

The **Working Oculars** vary in magnifying power from 4 upwards, and even their highest powers can be used with the greatest comfort. In all of them the eye-point (the exit pupil) lies sufficiently high above the upper lens surface, and the diameter of the lenses is sufficiently large, to completely obviate the inconveniences formerly attending the use of oculars of short focus.

We have modified one of the series of compensating oculars — the × 4 — fitting it with a collective lens of large diameter. Under this modification it is designated **Compensating Ocular 4***. As compared with the ordinary Compensating Ocular **4**, its field is considerably enlarged. To use this ocular with Stand **I**, the ocular-tube is unscrewed out of the draw-tube — with Stands **III** and **IV** the draw-tube is unscrewed at the shoulder — and the Compensating Ocular 4* screwed in instead. It is fitted with a revolving collar and can be fixed rigidly in any desired position by means of a clamping screw *K*. An iris-diaphragm, by means of which the area of the field may be varied at will — frequently a great convenience in demonstrations — takes the place of the ordinary fixed diaphragm. The eye-lens is mounted in a sliding sleeve, after the manner of our micrometer oculars thereby adapting it for use with a scale, &c., when desired.

Fig. 5.
Compensating Ocular 4* with iris-diaphragm.
(½ Full Size.)

The enlargement of the area of the visual field is, however, of real practical value only in the case of the lower-power objectives of **16 mm** and **8 mm**, because the sharp field of the higher powers is not sufficiently large to satisfactorily fill the field of this ocular.

Should this special ocular be employed on a Stand **III** *or* **IV**, *possessing neither Nose-piece or Sliding Objective-Changer, an intermediate adapting ring of definite length must be screwed into the main tube.*

Regarding the use of this ocular with a special form of ABBE's drawing apparatus see p. 73.

Compensating Oculars.

	Searcher ocular	Working oculars					
Distinctive No.:	**2**	**4**	**4***	**6**	**8**	**12**	**18**
Equivalent focal length in mm:	90	45	45	30	22.5	15	10
Price: Marks:	**20.—**	**20.—**	**40.—**	**20.—**	**30.—**	**30.—**	**25.—**
Codeword:	**Pagina**	**Pagote**	**Paguro**	**Paja**	**Pajada**	**Pajarel**	**Pajaro**

In subsequent orders for ocular 4* the factory number of the stand with which it is to be used should be stated.

When ordering oculars for stands of other makers it is necessary to send us an exact impression in sealing wax of the tube edge or, better still, to send the tube in question to our works.

Compensating oculars for the English tube. Beside those enumerated above the following compensating oculars are made to order for the 10-inch tube.

2^{e}: Equivalent focal length: 135 mm, Price: Mks. **25.—**. Code-word: **Pajarete.**
4^{e}: „ „ „ 67 „ „ „ **25.—**. „ **Pajarico.**
8^{e}: „ „ „ 34 „ „ „ **35.—**. „ **Pajarillo.**

The compensating oculars for the continental tube may also be used on the 10-inch tube, but in order to obtain correct ocular magnification for a tube-length of 250 mm (about 10 in.) it is necessary to multiply the figures engraved on the oculars by 1.5.

Table of Magnifications of the Apochromatic Objectives with the Compensating Oculars.

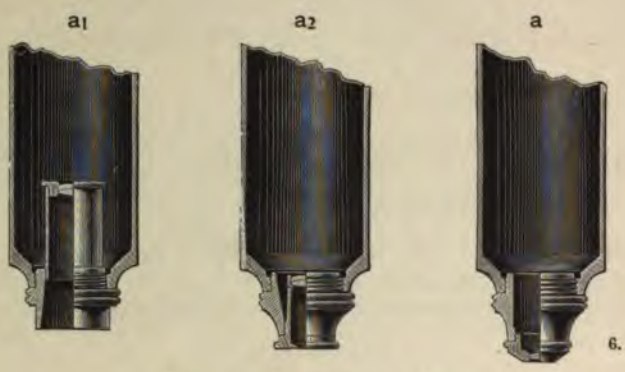
Calculated for 160 mm (about 6$^{1}/_{2}$ in.) tube-length and an image distance of 250 mm (about 10 in.).

Focus of the objective	Searcher ocular	Working oculars				
mm	**2**	**4 & 4***	**6**	**8**	**12**	**18**
16.0	31	62	94	125	187	281
8.0	62	125	187	250	375	562
4.0	125	250	375	500	750	1125
3.0	167	333	500	667	1000	1500
2.5	200	400	600	800	1200	1800
2.0	250	500	750	1000	1500	2250
1.5	333	667	1000	1334	2000	3000

In employing nose-piece or sliding objective-changer, the length of the nose-piece amounting to 15 mm, that of the sliding objective-changer to 22 mm, must be taken into account (see p. 8).

Achromatic Objectives.

Aided by the considerably extended list of materials produced by the local Glass Works we have reconstructed most of the older types of our achromatic objectives, the higher powers of the dry system have, moreover, received single lenses of fluorite, so as to obviate in these objectives also, more completely than had formerly been possible, imperfections due to spherical and chromatic aberration. With those systems of the dry series which have a numerical aperture exceeding 0.65 this improvement, apart from greater sharpness and clearness of the image, is also manifested by increased sensibility to differences in the thickness of the cover-glass and the length of tube. Consequently, in the use of these objectives now even closer attention must be given to these two points than formerly.



6.

Fig. 6. Objectives a_1, a_2^5, a_3, attached to the tube.
($^1/_2$ Full Size.)

7.

Fig. 7. Objective a*.
By rotation of the ring *RR* the upper pair of lenses (L_2) may be elevated into the position L_2', indicated by dotted lines.
(Full Size.)

Our lowest power objectives, viz: a_0, a_1, a_2 and a_3, are simple achromatic lenses, so mounted, that, notwithstanding their great focal length, the body of the microscope remains at its ordinary elevation during observation. For this purpose lenses a_0 and a_1 have their threads so situated that, when screwed into the tube, the lens is inside the body (see a_1, Fig. 6), and they cannot therefore be used with a revolving nose-piece or other objective-changer. Though the former is primarily intended for use with our binocular microscopes,

we now also supply it in a mount resembling that shown in Fig. 6 (a_1) thereby adapting it to other stands. *Should the systems* a_0 *and* a_1 *be employed on the Mineralogical Stand* III M *or Stand* XI *— which must be expressly so stated in the order — it is given a similar mount as the system* a_3*; they can then also be employed in combination with a nose-piece or sliding objective-changer. Mounted in this manner, the objectives produce a somewhat higher magnification.*

Objective a* (Fig. 7) consists of two achromatic lenses combined after an original formula of our own computation. By means of a ring *RR*, rotating like a correction-collar, the lenses may be brought closer together or separated, whereby, in combination with an ocular, the magnification can be so greatly varied that its power is approximately doubled by changing the position of the index from 0 to division 10 of the scale.

In the year 1890 we constructed the **Water Immersion D***. It facilitates the investigation of living micro-organisms and objects suspended in water at medium magnifications. Its great working distance gives to the microscopist a relatively wide range in following the motions of such creatures through both the upper and lower strata of the water. The peculiar construction of the system tends to restrict the greatest sharpness of the image to the central portion of the field.

The system may be used with or without cover-glass and gives equally good images with fresh as with sea water.

For the investigation of fluids by means of the Appliances for the investigation of Ultra-microscopical Particles, is the objective **D*** particularly adapted on account of its great free-working distance. See prospectus relating to Appliances for the investigation Ultra-microscopical Particles (M 164), p. 6.

The **Water Immersion Objective Pl,** an optical combination introduced by us in 1898 under the designation of the **Plankton-Searcher,** serves essentially the same purposes as the system just previously described. Owing to its long focus this objective yields only low magnifications, and though its aperture is 0.11, it gives the very large working distance of about 36 mm, and the depth of definition is considerable. The use of new kinds of glass, capable of resisting the influence of water, has facilitated a well-nigh apochromatic correction.

To facilitate the use of this objective, we supply a special glass cell No. **2030** *(glass slide with deep glass cylinder cemented thereon), suitable for use also with the paired objectives* (Pl).

	Marks	*Codeword*
Glass cell for **Pl** and (Pl)	3.50	**Pajarita**

List of the Achromatic Objectives.

	Designation	Equivalent focal length mm	Numerical Aperture	Combined with HUYGEN. Ocular 2; Tube-length 160 mm (about 6 1/2 in.) Free Working Distance mm	Diameter of visible area of object mm	Price without Correction-Collar Marks	with Correction-Collar Marks	Codeword
Dry Series	a_0	45	—	32	14	12.—		Pajeria
	a_1	39	—	20	11	12.—		Pajillo
	a_2	37	—	30	8	12.—		Pajonal
	a_3	28	—	33	4.5	12.—		Pajuncio
	a*	43—29	—	13—53	10—25	40.—		Pajuela
	aa	26	0.17	14	4	27.—		Palabra
	A	15	0.20	9	2	20.—		Palacial
	AA	17	0.30	7.5	2.5	30.—		Palacio
	B	12	0.35	3	1.5	30.—		Paladar
	C	7	0.40	1.8	0.9	30.—		Paladino
	D	4.2	0.65	0.6	0.5	35.—		Palamalle
	DD†)	4.3	0.85	0.4	0.5	50.—	70.—	Palamenta Palanca
	E†)	2.8	0.90	0.25	0.35	60.—	80.—	Palampora Palangana
	F†)	1.8	0.90	0.17	0.23	75.—	95.—	Palatal Palastro
Water Immersion	Pl	25	0.11	36	4	20.—		Palecer
	D*	4.4	0.75	1.5	0.55	75.—		Palente
	J	1.8	1.18	0.2	0.23	110.—	130.—	Paleton Paletero
Homog. Immersion	1/12"	1.8	1.30	0.15	2.05	125.—		Paliador

For definition of the terms "Free working distance" and "Diameter of visible area of object" see p. 16.

All these objectives are also supplied adjusted for the English 10-inch body (tube-length 250 mm [about 10-in.]).

With regard to the kind of immersion fluid to be used with homogeneous immersion objectives refer to pp. 10 and 11.

†) The Systems **DD, E, F** contain Fluorite Lenses.

*Paired Objectives for the Binocular Microscopes.

The combinations **Pl (Water Immersion)**, a_3, a_2, a_0 and one of still lower power, namely of **55** mm (about $2^1/_4$ in.) focal length, for use with binocular microscopes. are supplied in a special form of setting and mounted in pairs on metal slides.

We designate such paired objectives: (55), (a_0), (a_2), (a_3), (Pl).

Paired objectives	(55)	(a_0)	(a_2)	(a_3)	(Pl) Water Immersion
Price: Marks	45.—	45.—	45.—	45.—	55.—
Codeword:	**Palido**	**Palinodia**	**Palma**	**Palmado**	**Palmear**

A pair of suitable diaphragms to slip on, which should be used whenever it is desired to obtain an image perfectly uniformly sharp up to the margin, is supplied with each set of paired objectives.

Regarding the use of the paired objectives (Pl) see p. 21.

For tables of magnification, free working distance and area of visible field of the paired objectives Nos 1—4 in combination with the Binocular Microscope, see p. 26.

HUYGENIAN Oculars.

We supply HUYGENIAN oculars for use with achromatic objectives in five different powers. The various focal lengths of these oculars are serially graduated so that, with due regard to their peculiar variations in the position of their lower focal points, the magnifications × 3, 4, 5.5, 7 and 9 are obtained if the tube-length of 160 mm be maintained throughout.

We make also a **HUYGENIAN Ocular 2* with Iris-diaphragm** similar to the compensating ocular **4***. What has been said with regard to compensating ocular **4*** applies equally to this HUYGENIAN ocular **2***. (See p. 18.)

Regarding oculars for special purposes see under heading of Accessory Apparatus, pp. 86—89.

We would particularly emphasise the fact that HUYGENIAN oculars are designed for use with achromatic objectives only.

Concerning the employment of achromatic objectives with compensating oculars, it is to be pointed out that such oculars are only suitable therewith in the case of objectives of larger num. Ap., 0.85 and upwards, i. e., system DD and higher powers.

List of HUYGENIAN Oculars.

Ocular No.	1	2	2*	3	4	5
Equivalent focus in mm	50	40	40	30	25	20
Ocular magnification	3	4	4	5.5	7	9
Price: Marks:	6.—	6.—	30.—	6.—	6.—	6.—
Codeword:	Palmula	Palombin	Palomero	Palota	Palpebra	Palpitar

In subsequent orders for Ocular 2* the factory number of the stand should be stated.

For the safe-keeping of objectives and oculars, when stored outside the microscope cabinet, may mahogany lock-up cases (Fig. 8) be had in various sizes, at a price from M 18.— to M 40.—.

8.

Fig. 8.

Mahogany case for objectives and oculars.

Table of Magnifications of the Achromatic Objectives with HUYGENIAN Oculars,

calculated for a tube-length of 160 mm (about $6^1/_2$ in.) and an image distance of 250 mm (about 10 in.)

Objectives	HUYGENIAN Oculars				
	1	2 & 2*	3	4	5
a_0	4	6	10	12	20
a_1	7	10	16	20	30
a_2	11	15	23	28	41
a_3	20	26	38	47	68
a*	3—8	5—12	8—18	10—22	16—33
aa	24	31	46	56	81
A	44	56	78	97	144
AA	42	54	74	91	134
B	63	80	115	140	200
C	100	125	180	220	315
D	175	220	320	390	550
DD	175	220	320	390	550
E	270	340	495	600	860
F	415	520	760	930	1300
Pl	25	33	48	58	84
D*	175	220	320	390	550
J	415	520	760	930	1300
$\frac{1}{12}$"	420	530	770	940	1320

In employing nose-piece or sliding objective-changer, the length of the nose-piece amounting to 15 mm, that of the sliding objective-changer to 22 mm, must be taken into account (see p. 8).

Table of Magnifications of the higher powers of Achromatic Objectives with the Compensating Oculars,

Objectives	Compensating Oculars					
	2	4 & 4*	6	8	12	18
DD	110	220	330	440	660	990
E	180	360	540	720	1080	1620
F	260	520	780	1040	1560	2340
J	260	520	780	1040	1560	2340
$\frac{1''}{12}$	260	520	780	1040	1560	2340

Table of Magnifications, Free Working Distances and Diameters of the Area of Objects embraced by paired Objectives adjusted for Binocular Microscopes,

Paired Objectives		Paired Oculars							
		1		2		3		4	
Designation	Free working distance mm	Magnification	Diameter of visible area of object mm	Magnification	Diameter of visible area of object mm	Magnification	Diameter of visible area of object mm	Magnification	Diameter of visible area of object mm
(55)	70	8	13	10	13	13	10.5	15	7.5
(a_0)	54 without diaphragms | 40 with diaphragms	13	7.5	16	7.5	23	6.5	28	4.0
(a_2)	40	20	5.0	24	5.0	33	4.2	45	3.0
(a_3)	30	30	3.3	35	3.2	50	2.7	65	2.0
(Pl)	35	35	3.0	42	3.0	58	2.5	72	1.8

N.B. The objectives (Pl) may only be used as water-immersion objectives.

Stands.

The general form of stand of "continental" design, which originated in the type first introduced by G. OBERHÄUSER and was subsequently developed by E. HARTNACK, has undergone many important alterations within the course of the second half of the past century.

The introduction of the ABBE illuminating apparatus, various new features in the construction of the stage, and considerable improvement of the means of focussing mark the material progress which is particularly noteworthy in the case of monocular stands.

These fundamental changes in the construction of the older universal type of stand have demonstrated to us the necessity of also modifying our binocular stands, which we introduced some years ago.

In the last year or two we have made substantial modifications, aiming at simplification, in the construction of the medium and small stands, and regarding which, special prospectuses have already been published by us. They deal principally with the provision made for the subsequent addition of accessories to stage and illuminating apparatus of the stand in its simplest form, and at the same time, by avoiding all superfluous luxury of finish in the stand itself, reducing thereby the price of these stands as low as possible.

A. Illumination of the Object.

I. Illumination by transmitted light.

Modern microscopy relies mainly on illumination by transmitted light, with a concomitant facility for a wide variation of the incident pencil both as regards its angular aperture and its direction. Both these requirements are fully met by the **ABBE Illuminating Apparatus,** first introduced by us in 1872 (see E. ABBE in M. SCHULTZE's Archiv für mikrosk. Anatomie, vol. IX, 1873, pp. 469—480, and Gesammelte Abhandlungen, I, Jena 1904, pp. 101—112). The use of this apparatus has in the course of the last few decades become so general, and it has been so universally acknowledg

in advanced microscopic work, that it now justly forms an essential adjunct to all the larger stands intended for scientific research.

Particulars regarding the construction and application of this apparatus may be found in the detailed directions for use, which are issued with each stand fitted with the ABBE illuminating apparatus.

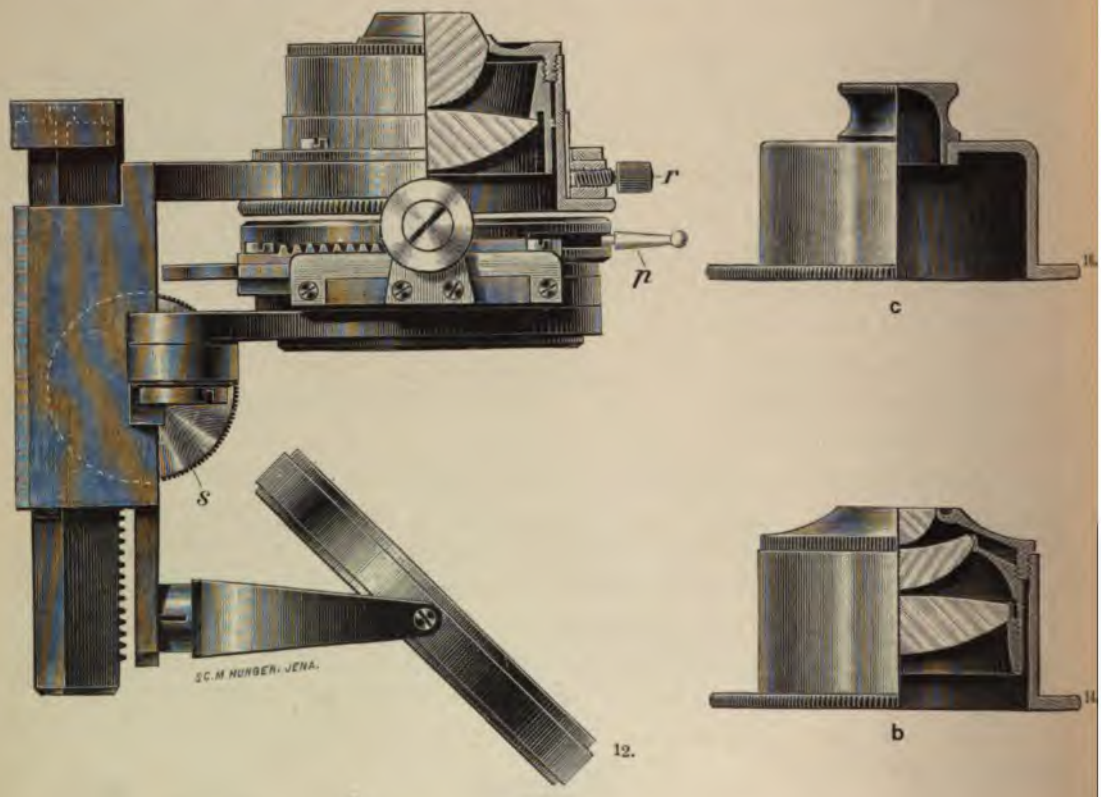


Fig. 9.

a: **ABBE Illuminating Apparatus with ordinary Condenser No. 25**; *r*: screw for clamping the condenser in the sliding sleeve; *p*: knob of iris-diaphragm No. 23; *b*: **ordinary Condenser No. 26**; *c*: **Cylinder-diaphragm** No. 21. (Full Size.)

The various lens systems — **Condensers** — which are adapted for use with the ABBE illuminating apparatus are all mounted in such a manner that they can be conveniently inserted into the **sliding sleeve** of the apparatus and may, if necessary, be clamped in any position. See Fig. 9. Since 1886 we have invariably added an **iris-diaphragm**, which facilitates a very gradual variation of the aperture.

We only supply the ABBE illuminating apparatus with one of the following stands: I, III and IV. Its adaptation to other stands — if at all practicable — must be carried out in our own works.

The various diaphragms, condensers, &c. used in connection with the apparatus are, however, supplied separately as follows:

No. **21.** The **Cylinder-Diaphragm,** Fig. 9c. A sliding tube fitted with 3 stops yielding apertures of 1 mm, 3 mm and 6 mm diameter.

No. **22.** The ***Iris-Cylinder Diaphragm.** In order to obtain a gradual variation of the illumination when working without a condenser, we have constructed the iris-cylinder diaphragm. The laminae forming the apertures of these diaphragms are arched in the shape of a cupola so that, when the iris is entirely closed, their edges almost touch the lower side of the object slide.

The cylinder-diaphragm No. **21** and the iris-cylinder diaphragm No. **22** can also be employed in the sliding sleeve of Stand **V.**

In subsequent orders for cylinder and iris-cylinder diaphragms the factory number of the stand with which they are to be used should be stated.

No. **23.** The **Iris-Diaphragm.** The ordinary iris-diaphragm, as always supplied with the illuminating apparatus, may also be obtained independently.

No. **24.** **Diaphragms for dark-ground illumination.** Since a rational employment of dark-ground illumination is only possible, when the dimensions of the stop are exactly adapted to the aperture of both objective and condenser, the various stops are only supplied to special order.

For the homogeneous immersion systems we will in future supply only a star-disc with central stops to be suspended in the objective mount above the lenses. Stopping down the illuminating cone of rays is thus not performed by means of a central stop in the diaphragm carrier, but through the ordinary iris-diaphragm.

In subsequent orders should be mentioned the objective and condenser for which the central stops are required. (See directions for the ABBE Illuminating Apparatus.)

Objectives with correction collars are unsuitable for the employment in dark-ground illumination.

	Marks	*Codeword*
Cylinder-diaphragm with **3 stops**	**4.—**	**Pantografo**
Iris-cylinder Diaphragm	**14.—**	**Pantuflo**
Iris-diaphragm for the diaphragm carrier	**10.—**	**Panzudo**
Stops etc. for dark-ground illumination		
a) Star-disc with button to support central stop	**0.50**	**Papado**
b) Central stop . . . . . each	**1.—**	**Papagallo**
c) Diaphragms to screw into the mounts of Achromatic objectives . . . . . each	**0.60**	**Papalina**
d) Diaphragms to slip into the mounts (from above) of Apochromatic objectives . . . . . each	**1.50**	**Papanatas**
e) Star-disc with central stop for homogeneous immersion objectives . . . . . each	**3.—**	**Papasso**

Nos. **25** and **26**. **Ordinary Condenser** in sliding tube, No. **25**: double lens formation (Fig. 9[a]), num. Ap. 1.20, equivalent focal length about 12 mm; No. **26**: triple-lens formation (Fig. 9[b]), num. Ap. 1.40, equivalent focal length about 8 mm.

Nos. **27** and **28**. ***Swing-out Condenser** with iris-cylinder diaphragm. Fig. 10; No. **27**: double lens, and No. **28**: triple lens formation.

This form of condenser was introduced by us in 1894 (see Zeitschr. f. wiss. Mikrosk., vol. XI, 1894, pp. 433—440). The apparatus offers the advantage of having the condenser and the iris-cylinder diaphragm combined. Fig. 10. By the aid of a suitable mechanism the condenser system may be folded clear of the carrier of the iris-cylinder diaphragm and swung aside so as to facilitate, by simple means, a change from illumination by mirror and condenser to that by mirror alone. For details of construction see Directions for Use of ABBE Illuminating Apparatus.

In subsequent orders for condensers specified under Nos. 25—28 the factory number of the stand should be stated.

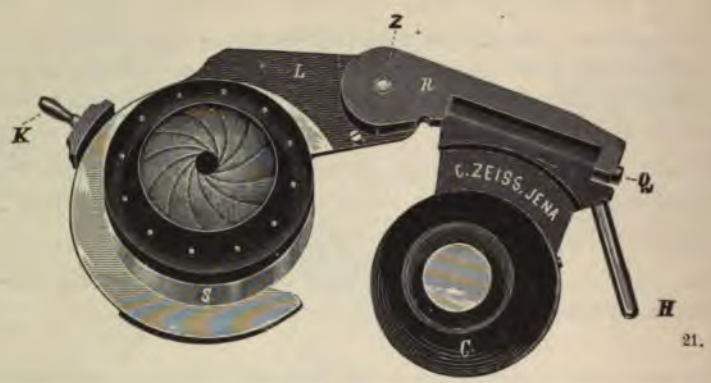


Fig. 10.
Swing-out Condenser with Iris-cylinder Diaphragm,
withdrawn from the sliding sleeve and condenser swung out.
($^3/_4$ Full Size.)

No.		*Marks*	*Codeword*
	Ordinary Condenser in sliding tube		
25	Double lens formation, num. Ap. 1.20	**20.—**	**Papaga**
26	Triple lens formation, num. Ap. 1.40	**25.—**	**Papelear**
	Swing-out Condenser with Iris-cylinder Diaphragm		
27	Double lens formation, num. Ap. 1.20	**45.—**	**Papeleta**
28	Triple lens formation, num. Ap. 1.45	**50.—**	**Papenco**

No. 29. ***Centring Achromatic Condenser,** numerical aperture 1.0, equivalent focal length 14 mm. Fig. 11 p. 32.

In this form of condenser, stopping down the illuminating rays is effected by means of an iris-diaphragm situated between the lenses, wherefore the diaphragm of the illuminating apparatus should remain fully open.

No. 30. ***Centring Achromatic Condenser possessing great distance between its focus and its front lens,** numerical aperture and focal length as above. This form of condenser was suggested by Professor ROLLETT of Graz. It is specially designed to admit of the use of ZOTH's cooling trough which should be placed directly below the object (see p. 93).

The aperture is regulated by means of the iris-diaphragm of the illuminating apparatus.

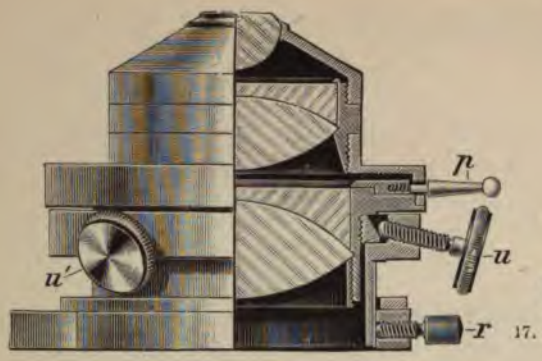
No. 31. ***Centring Achromatic Condenser with enlarged aperture,** numerical aperture 1.30, equivalent focal length 9 mm. By virtue of its large numerical aperture this condenser admits of the application of an exceptionally large or of a very oblique illuminating cone, unaffected with the pronounced aberrations invariably present in the cone of rays yielded by ordinary non-achromatic condensers. The slides used with this apparatus may not exceed a thickness of about 0.7 mm.

The aperture is here also regulated by means of the iris-diaphragm of the illuminating apparatus.

Regarding the advantages of the Achromatic Condenser over the ordinary, see our catalogue relating to Micro-photographic Apparatus, 5th Edition 1903, p. 31.

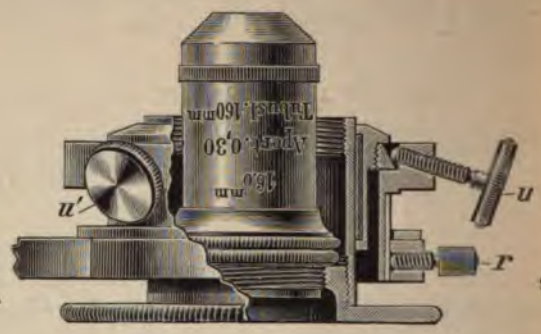
The Centring Achromatic Condensers Nos. 29—31 are inserted bodily into the sliding sleeve of the illuminating apparatus from above, and in order to permit this insertion, the microscope should be canted and the illuminating apparatus racked well down.

	Marks	*Codeword*
Centring Achromatic Condenser, num. Ap. 1.0, in case .	75.—	**Papion**
Centring Achromatic Condenser, num. Ap. 1.0, with great distance between focus and front lens, by **ROLLETT,** in case	100.—	**Papula**
Centring Achromatic Condenser, num. Ap. 1.30, in case .	100.—	**Paquira**



17.

Fig. 11.
Centring Achromatic Condenser
No. 29. (Full Size.)



20.

Fig. 12.
Centring Appliance for Objective as Condenser
No. 32. (Full Size.)

No. **32**. ***Centring Appliance for Microscope Objectives** used as condensers. Fig. 12.

In many instances it appears desirable to use achromatic, or also apochromatic, objectives as illuminators instead of the condensers specified above. For this purpose we supply a sliding sleeve with centring collar into which such objectives may be screwed and which fits into the sleeve of the illuminating apparatus.

No. **34**. ***Engelmann's Micro-spectral Objective,** for observing the effect of individual colours of the spectrum upon microscopical objects (see Bot. Zeitung, vol. XL, 1882, pp. 419—426; also Pflüger's Archiv f. d. ges. Physiol., vol. XXVII, 1882, pp. 485—490).

No. **35**. ***Rollett's Spectro-Polariser,** as modified by Dippel, for determining the character and degree of double refraction in microscopical objects (see Zeitschrift f. Instrumentenkunde, vol. I, 1881, pp. 366—372, and Dippel, loc. cit., p. 619).

With selenite films for red of the II. and red of the III. order.

No. **36**. **Centring Appliance** for the apparatus under Nos. **34** and **35**.

No.		*Marks*	*Codeword*
32	**Centring Appliance for Micro-objectives** used as Condensers	**12.—**	**Parabanda**
34	**Engelmann's Micro-spectral Objective,** in case	**160.—**	**Paradigma**
35	**Rollett's Spectro-Polariser,** in case	**200.—**	**Paradura**
36	**Centring Appliance** for apparatus specified under Nos. **34** and **35**	**8.—**	**Parafraste**

For Stands **V** and **VI**, which are not equipped with the ABBE Illuminating Apparatus, we supply suitable condensers and iris-diaphragms in another form. These are as follows:

a. For Stand V.

No. **37**. ***Simplified Illuminating Apparatus** with condenser system num. Ap. 1.20 in sliding tube with centrally fitted iris-diaphragm. It is inserted into the fixed sliding sleeve similarly as in the apparatus No. **38** and **3805** from below the stage.

No. **38**. ***Simplified Illuminating Apparatus** with swing-out condenser num. Ap. 1.20 and centrally fitted iris-diaphragm. The condenser proper is the same as in the apparatus No. **41**. See p. 34.

No. **3805**. ***Simplified Illuminating Apparatus** with condenser system num. Ap. 1.20 and centrally fitted iris-diaphragm.

To the condenser system or to the iris-diaphragm of apparatus No. ***3805*** *can the under part of the Polariser* **II** *No.* ***161*** *be attached.* *See p. 54.*

Besides the condensers with centrally fitted iris-diaphragm, specified under Nos. **37**, **38** and **3805**, there can be also inserted into the sliding sleeve of Stand **V** the cylinder-diaphragm No. **21** and the iris-cylinder diaphragm No. **22**. On the other hand the achromatic condensers, the centring device for objectives, the star-disc and central stops No. **24 a**, **b** for dark-ground illumination, the Polariser No. **160**, the apparatus for illumination with spectral analysed light can *not* be used on Stand **V**.

No. **3810**. **Iris-diaphragm for the simplified Illuminating Apparatus** No. **3805**. We supply this iris-diaphragm also alone, since when employing Polariser No. **161** it can be inserted between the condenser system and the NICOL's prism.

	Marks	*Codeword*
Simplified Illuminating Apparatus for Stand **V** with ordinary Condenser num. Ap. 1.20	**30.—**	**Parafuego**
swing-out Condenser num. Ap. 1.20	**55.—**	**Paraguas**
Simplified Illuminating Apparatus, with Condenser num. Ap. 1.0, and Iris-diaphragm, for Stand **V**	**24.–**	**als**
Iris-diaphragm of apparatus No. **3805** alone		

b. For Stand VI[a].

Similarly as in Stand **V** there is provided a sliding sleeve below the stage in Stand **VI[a]**, which, however, has only a diameter of 20 cm. Suitably adapted for this sliding sleeve we supply:

No. **39.** **Cylinder Diaphragm** with three stops.
No. **40.** ***Iris-cylinder Diaphragm.**
No. **41.** ***Illuminating System,** double lens formation num. Ap. 1.0, focal length about 7 mm, with centrally fitted iris-diaphragm.

In subsequent orders for No. 40 or 41 the cylinder-diaphragm belonging to the Stand should be forwarded.

II. Illumination by incident light.

In the examination of opaque objects, metal specimens, etc., an appliance for adequately lighting up the specimens from above is indispensable. If the free working distance of the objective used be very large, it generally answers sufficiently well to illuminate the object by the direct rays of daylight or lamplight, but, if necessary, the condition of the light may be improved by means of a collective lens placed before the microscope (see under heading of Accessory Apparatus, p. 91). When, however, the available working distance is small, an appliance for passing the light through the objective becomes necessary. This requirement is met by the **Vertical Illuminator,** constructed now by us for a considerable time past.

No. **42.** ***Vertical Illuminator,** Fig. 13. The rays issuing from the source of light enter through a lateral opening in the mount of the apparatus, strike the

No.		*Marks*	*Codeword*
39	**Cylinder Diaphragm** with three stops	**2.—**	**Paralaje**
40	**Iris-cylinder Diaphragm**	**8.—**	**Paralelo**
41	**Illuminating system,** double lens formation, num. Ap. 1.0, with iris-diaphragm	**22.—**	**Paralizar**
42	**Vertical Illuminator**	**18.—**	**Paramento**

hypotenuse surface of a reflecting prism, which covers one half of the aperture of the objective, and are thence totally reflected through the objective and concentrated upon the object.

Fig. 13.
Vertical Illuminator No. 42.
A: view of same (partly sectional) attached to the lower tube and the objective **C** — the latter in short mount; *p:* reflecting prism. *B:* plan view; *K:* milled knob for revolving the prism.
(Full Size.)

As it is of importance for the efficient working of the apparatus that the upper lens of the objective should be as close to the prism as possible, most objectives intended for work with a vertical illuminator should be fitted in special mounts.

Preparations under a cover-glass are not suitable for examination with the apparatus, unless homogeneous immersion systems are being employed; again, the higher powers of the Apochromats, **8 mm** and upwards, and the Achromats, **D** and upwards, with the exception of the homogeneous immersion systems, must therefore be specially corrected for investigation of uncovered objects.

It is furthermore of great advantage to reduce the diameter of the image of the source of light so that the illuminated portion of the object may not be greater than the area of the visual field of the objective used. The readiest means to attain this object is by placing the Collective Lens with Iris-Diaphragm No. **201** in the most favourable position before the microscope. See Directions for Use of the Vertical Illuminator.

No. **43**. **An illuminating appliance employing an incandescent lamp, by the aid of which intense light may be at once directed upon any particular point to be examined, is provided for use with Stand X^{c}, known under the designation of the Corneal Microscope. Similar appliances are also applicable to our other binocular stands (see p. 63).**

	Marks	*Codeword*
Illuminating appliance by means of small incandescent lamps for Stand **X**, including 3 reserve incandescent lamps	**36.—**	**Parangon**

B. The Stage.

The **dimensions of the stages** of all our microscope stands, are sufficiently large to allow of any size of object slide or carrier being used.

The **opening of the stage** has in most of the stands a diameter of 33 mm ($1^5/_{16}$ in.) in order that the large field possessed by the objectives of long focus may be fully utilised. It may, however, be reduced by the insertion of a diaphragm (the stage diaphragm) which is supplied with each instrument.

In Stand **VI**[a] the diameter of the stage opening is only about 20 mm (about $^3/_4$ in.).

Revolving Stages are fitted to Stands **I** and **III** M; such stages may be subsequently fitted to the other varieties of Stand **III** as well as to Stands **IV** and **V**.

Mechanical Stages, i. e., mechanical means of moving the object within the plane of the stage in two directions at right angles to each other, may be fitted to Stands **I**, **III**, **IV** and **V**.

No. **44**. The * **Large Mechanical Stage,** Fig. 14. The range of the movements of this pattern of stage is 50 mm (2 in.) in one direction and 35 mm ($1^3/_8$ in.) in the other; the readings of variations in either direction are taken from scales and verniers. (See Zeitschr. f. wiss. Mikrosk., vol. XI, 1894, pp. 301—304.) In the latest models a **third scale and vernier** is added for recording the positions of the movable cheek-piece which secures the object slide. This arrangement facilitates the convenient use of the apparatus as a **"finder"**, and the process of centring is at the same time much simplified by the addition of a **centring-glass** — an **object slide having a cross ruled upon it.** (For particulars see the directions for using this apparatus.)

No. **45**. **Revolving Vulcanite Stage.** This stage can be used interchangeably with the Large Mechanical Stage No. **44**. To effect this the clamping screw *b* is removed and the two centring screws unscrewed so far, that the stage

No.		*Marks*	*Codeword*
44	**Large Mechanical Stage for Stands I, III** and **VI**	**100.—**	**Paranza**
45	**Revolving Vulcanite Stage** interchangeable with the Large Mechanical Stage in Stands **I, III** and **IV**	**25.—**	**Parar**

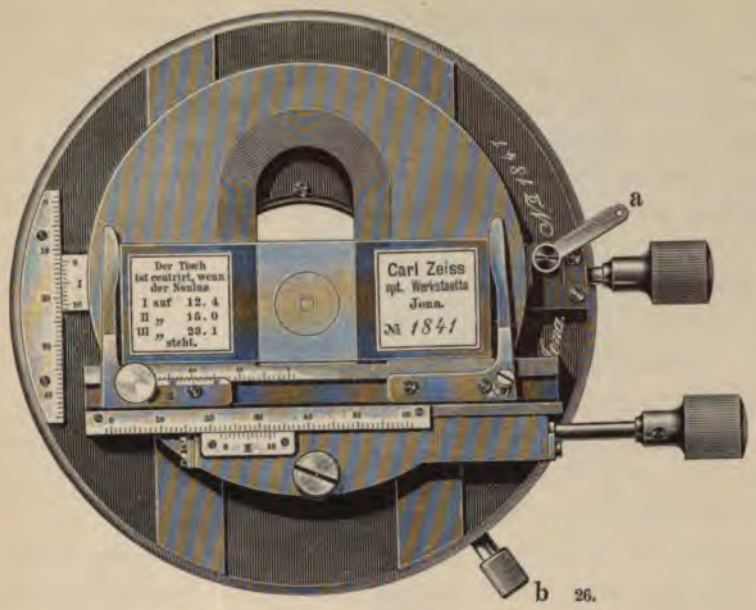


Fig. 14. Large Mechanical Stage, No. 44.

a: lever for securing the lower sliding piece; *b:* clamping screw to arrest the turning movement.

($^2/_3$ Full Size.)

no longer follows; the stage is then pressed gently forward, raising the hinder part first and then lifting the stage out of its centring appliance. It should be observed that, in inserting another stage, the spring steel pin, housed in front part of the bed, engages in the groove situated in the turning ring of the stage proper.

The stages Nos. 44 and 45 may be inserted into the centring appliance in the Stands* I, III *and* IV *and can, forthwith, be interchangeably used one after the other.

***Photo-micrographic Stage.** For photo-micrographic and projection purposes it is particularly desirable to be able to impart a very slow motion to the object and simultaneously to rotate the stage round the optical axis of the microscope. Both these requirements are met by our **photo-micrographic stage.** It has a diameter of 100 mm (4 in.) and may be moved in two directions at right angles to each other within a margin of 10 mm ($^3/_8$ in.) by means of two **co-axial milled-heads.** The amount of the movements is read by two separate scales and verniers. Having no centring appliance, this stage is not interchangeable with the large mechanical or the revolving vulcanite stage.

For this reason we supply the photo-micrographic stage nection with Stands I C No. **5805** and **5810.**

No. 46. ***Attachable Mechanical Stage (old pattern)**, Fig. 15.

The construction of this stage is based in its essential features upon the principle evolved by Mr. J. MAYALL junr. (see Journal Roy. Microsc. Soc. (2), V. p. 1885). Two sliding pieces, mounted at right angles to, and in immediate contact with, one another, are moved by means of two milled-heads. Their various positions are recorded by scales and verniers. The range of the lateral movement is 50 mm (2 in.), that of the movement from front to rear 30 mm (1 3/16 in.). The apparatus may also be used as a **"finder"** (see directions for using this accessory).

No. 47. ***Attachable Mechanical Stage (new model)**, Fig. 16.

The **milled-heads** which cause the movement of the sliding pieces are **co-axial** in this pattern of traversing stage and retain their relative positions in turning. The lateral movement may be effected with either the right or left hand.

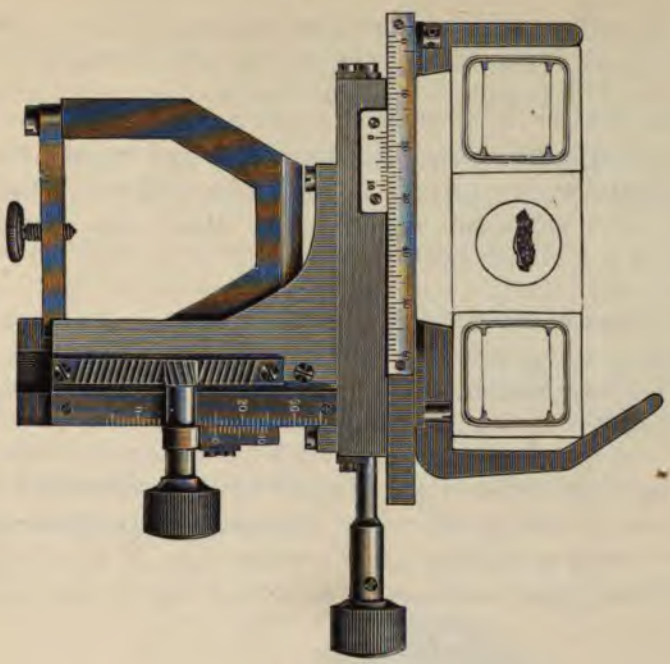
The margin of movement is slightly greater than with the small mechanical stage, No. **46**; the area which can be effectively searched measures about 60 × 30 mm (about 2 3/8 × 1 3/16 in.).

The peculiar mechanism of this stage guarantees a considerably greater security in the movement of the sliding pieces and fulfils all requirements of a movable stage when applied to the purposes of a **"finder"**.

An accurately gauged **centring-glass**, upon which the divisions of the crossed line are marked from two edges of the slide, is supplied with each stage No. **47**. (See Zeitschr. f. Instr.-Kde., vol. XX, 1900, pp. 325—327; see also the directions for using the stage.)

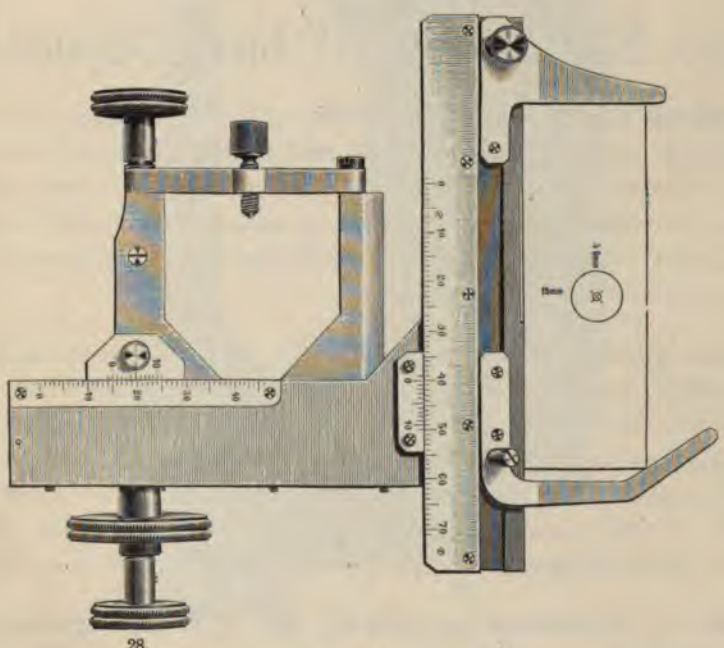
The Attachable Mechanical Stages Nos. 46 and 47 are attached to the prism flange of the Stand: they are designed for use on our Stands IV A—C and V A—C only and can be attached to these Stands without any special adaptation.

	Marks	*Codeword*
Attachable Mechanical Stage (old pattern)	85.—	**Parasito**
Case for No. 46	5.—	**Parazonio**
Attachable Mechanical Stage (new model)	120.—	**Parcial**
Case for No. 47	5.—	**Parcidura**



27.

Fig. 15.
Attachable Mechanical Stage, No. 46. ($^2/_3$ Full Size.)



28.

Fig. 16.
Attachable Mechanical Stage, No. 47. ($^2/_3$ Full Size.)

Besides the mechanical and revolving stages, auxiliary apparatus serving the purpose of moving microscopical objects may also be employed.

The **Prism Rotator** is a suitable accessory to the Binocular Stand **X^a** and also to other stands having a stage aperture of 33 mm (about 1 3/8 in.) diameter. The **Capillary Rotator** may be used in connection with stands having a smaller stage aperture. (For particulars regarding the above two appliances refer to pp. 89 and 90.)

For the purpose of determining the amount of very delicate movements in one particular direction, especially where exact measurements of horizontal displacements are in question, our Stage Screw-Micrometer (see p. 78) will be found useful.

We may here also mention the ***MALTWOOD Finder*** *(see Zeitschrift f. wiss. Mikrosk., vol. V, 1888, p. 40), which is an auxiliary appliance for refinding any particular spot in a specimen under examination. It is a "finder" appliance of the simplest description and may be used with any of our movable stages. (See p. 93.)*

C. The Focussing of the Objectives.

The coarse adjustment. The whole of the microscope stands specified in this catalogue are provided with **rack and pinion** for the coarse adjustment. We have constructed special machines for the accurate production of the oblique toothgearing, and this motion is now made in such perfection that even objectives of medium power can be focussed with sufficient exactness by it alone without the use of the micrometer-screw.

The fine adjustment. The micrometer movement introduced by us in 1886 (see Zeitschr. f. wiss. Mikroskopie, vol. III, 1886, pp. 207—209) has during this long period been in extensive use and has proved absolutely satisfactory. We have therefore retained it in the Stands **IV, V** and **VI.** The superiority of this is mainly due to the fact that the force exercised by the micrometer-screw is transferred to the movable body by a single contact between two hardened steel surfaces, which ensures an extremely delicate and uniform motion.

In 1898 we introduced an entirely new type of construction of the upper part of the Stand. The coarse adjustment by means of rack and pinion was retained, **but the mechanism for fine adjustment underwent a complete change.**

The then generally used prismatic movement was discarded in favour of one by means of slides. The sliding piece itself is situated close behind the coarse adjustment action, with which it is rigidly connected by screws. See Fig. 17.

A **worm-wheel,** movable by means of an **endless screw,** is situated at the lower end of the micrometer-screw and serves in a sense as a screw-head. See Fig. 17.

Here also the force exercised by the micrometer-screw is transferred to the movable body which carries the tube by a single contact between two hardened steel surfaces.

The whole mechanism, with the exception of the two milled-heads acting upon the endless screw, is enclosed inside the **crane-shaped carrier** and is thus **protected against all direct damage from outside.** An additional safety appliance prevents injury to the micrometer-screw when the sliding piece has reached the limits of its movement.

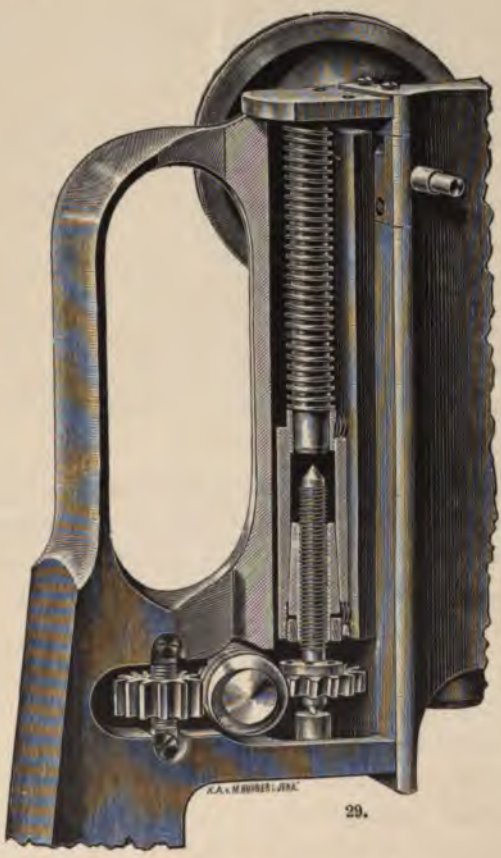


Fig. 17.
Berger's Micrometer Movement.
(Full Size.)

As the axes of the milled-heads used in the fine and coarse adjustment are parallel, and as in elevating and depressing the tube both turn in the same direction, the change from one movement to the other is most convenient for the hand of the operator.

As regards details of construction we would refer to the article: "Ein neuer Mikroskop-Oberbau", Zeitschrift für Instrumentenkunde, vol. XVIII, 1898, pp. 129—133.

The **divisions on the milled-head** of the old type of micrometer movement, as applied to our Stand **IV** enables one to read movements of 0.005 mm of the tube in the direction of the optical axis. **One of the milled-heads of BERGER's micrometer movement** is also provided with a **divided scale**, each division of which corresponds to a **variation of 0.002 mm in the position of the tube.**

By means of above **measurements of thickness** may be made with a considerable degree of accuracy. The upper and lower surfaces of the object are successively focussed and the respective positions of the index read off on the divisions of the milled-head. The difference between the two readings — objectives of the dry series being used — then represents the thickness of the corresponding stratum of air.

If the refractive index of the object be known, its actual thickness may be approximately ascertained by means of this also. Inversely, the refractive index of an object may also be approximately determined if its thickness be known. Assuming $d =$ the difference between the two readings, $D =$ the actual thickness of the object, and $n =$ its refractive index, then — although approximately only — the formula

$$D = n\,d$$

holds good.

In, for instance, estimating the thickness of a cover-glass, n may be assumed to be equal to 1.5 without risk of appreciable error.

In taking measurements of this kind it is best to use one of the higher dry lenses and a medium ocular, using central illumination.

With regard to the execution of more exact measurements of thickness by the aid of the micrometer-screw see an article by S. CZAPSKI on "Die Bestimmung von Deckglasdicken an fertigen Präparaten" (Zeitschr. f. wiss. Mikrosk., vol. V, 1888, pp. 482—484).

The draw-tube, which is possessed by all stands, with the exception of the Stands **IX, X, XI** and the Hand-microscope admits of being increased or diminished; the existing **tube-length** (see pp. 8 and 9) can be read by means of a scale engraved on the draw-tube, whereby the length of any apparatus — **nose-piece**, objective changer and the like inserted between tube **and objective** — may be duly compensated for (see pp. 8 and 9). **The lower end is** provided with the standard screw to take an objective of lower **power, as, for** instance, the auxiliary objective used with the apertometer. This **standard screw**

is only absent in the inner tube of the large mineralogical Stand III M; instead of a screw thread a slide is made use of, into which the BERTRAND Lens can be inserted from the outside. (See pp. 50 and 51.)

The **internal diameter of our draw-tube** is 23.3 mm at **the ocular end.**

D. Appliances for Changing the Objectives on the Stand.

Revolving Nose-pieces or **Sliding Objective-changers** are appliances designed to facilitate the rapid and commodious interchange, while interfering as little as possible with the focussing and centring, of the objectives.

The sliding objective changers are in so far superior to the revolving nose-pieces that they admit of the maintenance of the focussing and centring with much greater precision than the latter are ever capable of giving. Another advantage is that in using them the number of objectives is not restricted to any particular limit.

In using nose-piece or objective-changer, the length of the nose-piece (15 mm) and that of the objective-changer (22 mm) should be taken into consideration, and the draw-tube shortened by the like amount. (See p. 8.)

Nos. **48—50. Revolving Nose-pieces,** Fig. 18. A clamping ring with milled edge serves to fix the nose-piece in any desired position — as a rule so as to have the objectives not in actual use turned symmetrically towards the front. The objectives are screwed into the nose-piece and can by a simple turn be placed in rapid succession in alignment with the tube, the correct position being indicated by the snapping of a

A curved cover, turn
the openings into which the ob

We supply revolving nose-pieces to receive 2, 3 and 4 objectives.

Revolving Nose-piece, No. 48, for 2 objectives.

Revolving Nose-piece, No. 49, for 3 objectives.

Fig. 18.

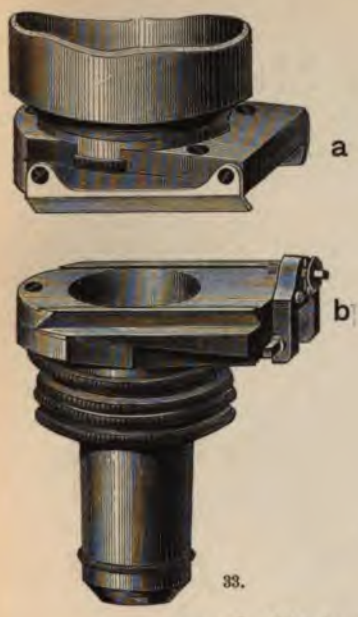
Revolving Nose-piece, No. 50, for 4 objectives.
(Full Size.)

Nos. **52** and **53**. ***Sliding Objective-changers,** Fig. 19. This apparatus is so arranged that the observer himself may centre each separate objective and it admits of the use of an unlimited number of objectives.

The **tube-slide,** No. **52**, Fig. 19[a], is screwed on the end of the body like an ordinary revolving nose-piece and may be secured with the slide action either pointing to the front or turned sideways.

The plane of the tube-slide is inclined to the axis of the tube at an angle of about 84°. The plane of the **objective-slide,** No. **53**, is inclined at a corresponding angle so that, on being withdrawn, the objective moves slightly away from the specimen. A screw — turned by a watch key — serves as a

No.		*Marks*	*Codeword*
48	**Revolving Nose-piece** for two objectives	**15.—**	**Pardal**
49	„ „ „ „ three „	**20.—**	**Pardina**
50	„ „ „ „ four „	**25.—**	**Pardogris**
	Sliding Objective-changer		
52	Tube-slide	**8.—**	**Pareja**
53	Objective-slide, each	**8.—**	**Parental**



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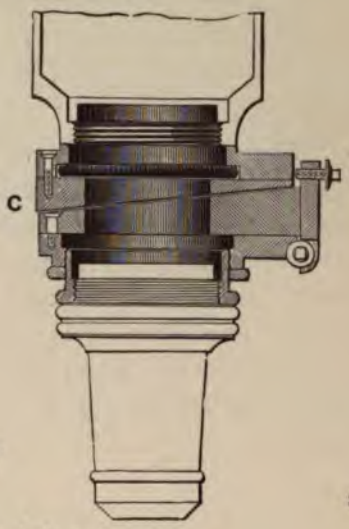


34.

Fig. 19.
Sliding Objective-changer.

a: tube-slide; b: objective-slide with objective attached; c: in section.
(Full Size.)

centring adjustment in the direction of the slide, while an endless screw (at right angles to the first-mentioned and, like it, regulated by a watch key) effects the centring of the objective at right angles to the slide.

Objectives having their mounts so adjusted as to be approximately in focus when changed can also, by means of the screw-collar on the objective slide, be accurately focussed and then permanently fixed in their proper position by a locking nut.

We are prepared, at request, to adjust in our Works with the greatest care several objectives to be used on a revolving nose-piece or with sliding objective-changers to one focal plane, with the exception of the systems **a**, **aa**, **a*** *and the immersion systems, if objectives and objective-changers be obtained at the same time, but we must expressly remark that this adjustment is accurate only when the correct tube-length is maintained.*

Nos. 54 and 55. For the convenient safe-keeping of objectives with objective-slides attached to them, we supply, when requested, special cases in various sizes. The most usual forms are the leather case No. 54 for 3 objectives with their slides, and the mahogany case for 6 objectives with their slides.

	Marks	*Codeword*
Leather case for 3 Objective-slides and Objectives	6.—	**Parhilera**
Mahogany case for 6 Objective-slides and Objectives	15.—	**Parida**

E. Various Models of Stands.

Large Stands.

Stand I is the ground form of our **large stands,** and is supplied equ with the complete ABBE Illuminating Apparatus, which is arrang that all condensers and the like inserted into the sliding sleeve of this App may be employed. (See pp. 29 to 32.) The upper part may be inclined that the tube lies in a horizontal position. From the large diameter o outer tube **Stand I** is suitable for Micro-photography and Projec not merely with the ordinary microscopic objectives but also with the I planars (see our catalogue relating to Apparatus for Micro-photography anc jection).

Stand I.

Upper part with BERGER's Micrometer Movement; outer tube; draw-tube slidable in a tubular sleeve. Tube-carrier pro with strong handle for lifting the instrument. In lock-up mahog cabinet.

We supply **Stand I** in the following different forms:

No.		*Marks*	*Code*
	A: With Revolving Vulcanite Stage No. **45.**		
5605	**Stand I** A with ordinary Condenser, num. Ap. 1.40. . . .	**325.—**	**Parie**
5610	**Stand I** A with swing-out Condenser, num. Ap. 1.40 . . .	**350.—**	**Parie**
	B: With large Mechanical Stage No. **44.**		
5705	**Stand I** B with ordinary Condenser, num. Ap. 1.40. . . .	**400.—**	**Parili**
5710	**Stand I** B with swing-out Condenser, num. Ap. 1.40 . . .	**425.—**	**Parili**
	C: With Micro-photographical Stage and the accessories: **Light-excluding Funnel, Adapting Rings for the Micro-Planars to screw in, Centring Stop, Dark Glass.**		
5805	**Stand I** C with ordinary Condenser, num. Ap. 1.40. . . .	**415.—**	**Parin**
5810	**Stand I** C with swing-out Condenser, num. Ap. 1.40 . . .	**440.—**	**Parip**
	D: The same Stand as I A, **but with the accessories specified under C.**		
5905	**Stand I** D with ordinary Condenser, num. Ap. 1.40. . . .	**340.—**	**Parisi**
5910	**Stand I** D with swing-out Condenser, num. Ap. 1.40 . . .	**365.—**	**Parisi**
	E: The same Stand as I B, **but with the accessories specified under C.**		
6005	**Stand I** E with ordinary Condenser, num. Ap. 1.40. . . .	**415.—**	**Parju**
6010	**Stand I** E with swing-out Condenser, num. Ap. 1.40 . . .	**440.—**	**Parla**

Fig. 20.
Stand I B, No. 5705, with large mechanical stage No. 44.
($^1/_2$ Full Size.)

Medium Stands.

Stands III and **IV** but recently introduced are the ground forms of medium sized stands. Both are constructed so as to enable subsec additions to stage and illuminating apparatus being made.

Avoiding all luxury of finish we have substituted a cast metal foot a slightly roughened lacquered surface for the former customary highly turnec polished foot, and further, for the expensive mahogany cabinet one of poli alderwood. The mineralogical stand, designated as **Stand III M**, which we recently fitted with BERGER's Micrometer Movement, is supplied in a maho cabinet.

Stand III.

Upper body fitted with BERGER's Micrometer Movem Under part with arrangements for subsequent additions to stage and illu ating apparatus. Lock-up polished alderwood cabinet.

We supply **Stand III** in the following different forms:

No.		*Marks*	*Codew*
6105	**Stand III** A, with fixed round stage of 11 cm diameter and Cylinder-diaphragm No. **21**	**205.—**	**Partout**
6205	**Stand III** B, with stage as in **III** A and ordinary Condenser num. Ap. 1.20, together with Iris-diaphragm	**235.—**	**Parturi**
	III A and **III** B can be supplemented by subsequently adding:		
	No. **6220. The Diaphragm-carrier**	**20.—**	**Paruer**
6305	**Stand III** C, with stage as in **III** A, complete ABBE Illuminating Apparatus with ordinary Condenser num. Ap. 1.20	**250.—**	**Parusia**
6310	**Stand III** C, but with swing-out Condenser num. Ap. 1.20	**275.—**	**Parvale**
	III A, **III** B and **III** C can be supplemented by subsequently adding:		
	No. **6320. Revolving Vulcanite Stage** including centring appliance	**42.—**	**Parveni**
	No. **6330. Large Mechanical Stage** including centring appliance .	**117.—**	**Parvien**
6405	**Stand III** D, with Revolving Vulcanite Stage No. **6320** ABBE Illuminating Apparatus with ordinary Condenser num. Ap. 140 . . .	**290.—**	**Parvoli**
6410	**Stand III** D, as above but with swing-out Condenser num. Ap. 1.40	**315.—**	**Parvulo**
6505	**Stand III** E, with Large Mechanical Stage No. **6330,** ABBE Illuminating Apparatus with ordinary Condenser num. Ap. 1.40 . . .	**365.—**	**Parzival**
6510	**Stand III** E, as above but with swing-out Condenser num. Ap. 1.40	**390.—**	**Pasabal**

If the Stands III A — III E are not to be supplied in an alderwood but in a mc gany cabinet, Marks 20.— must be added to the prices of the various specificati

Fig. 21.
Stand III B, **No. 6205, with Diaphragm-carrier** B, **No. 6220, and its Key** (C).
($^1/_2$ Full Size.)

Stand III M.

Stand for crystallographic and petrographic investigations.

The focussing appliances and tube-carrier the same as in other models of Stand **III**; Draw-tube, with rack and pinion, is at the lower end provided with slide to admit mounted AMICI-BERTRAND lens through an opening in the outer tube. In lock-up mahogany cabinet.

Stands **III** M are furnished with: Polariser I, Analyser — with graduated circle — capping the ocular, Analyser mounted slidable immediately above the objective, Selenite plate Red of the I. Order, Mica plate $^1/_4$ λ, BIOT-KLEIN Quartz plate; suitable arrangements are made allowing these crystal plates being inserted in a sliding-carrier situated above the objective.

The objectives **a_0** and **a_1** can be used on Stand **III** M when they are supplied in a special mount only. (See p. 21.)

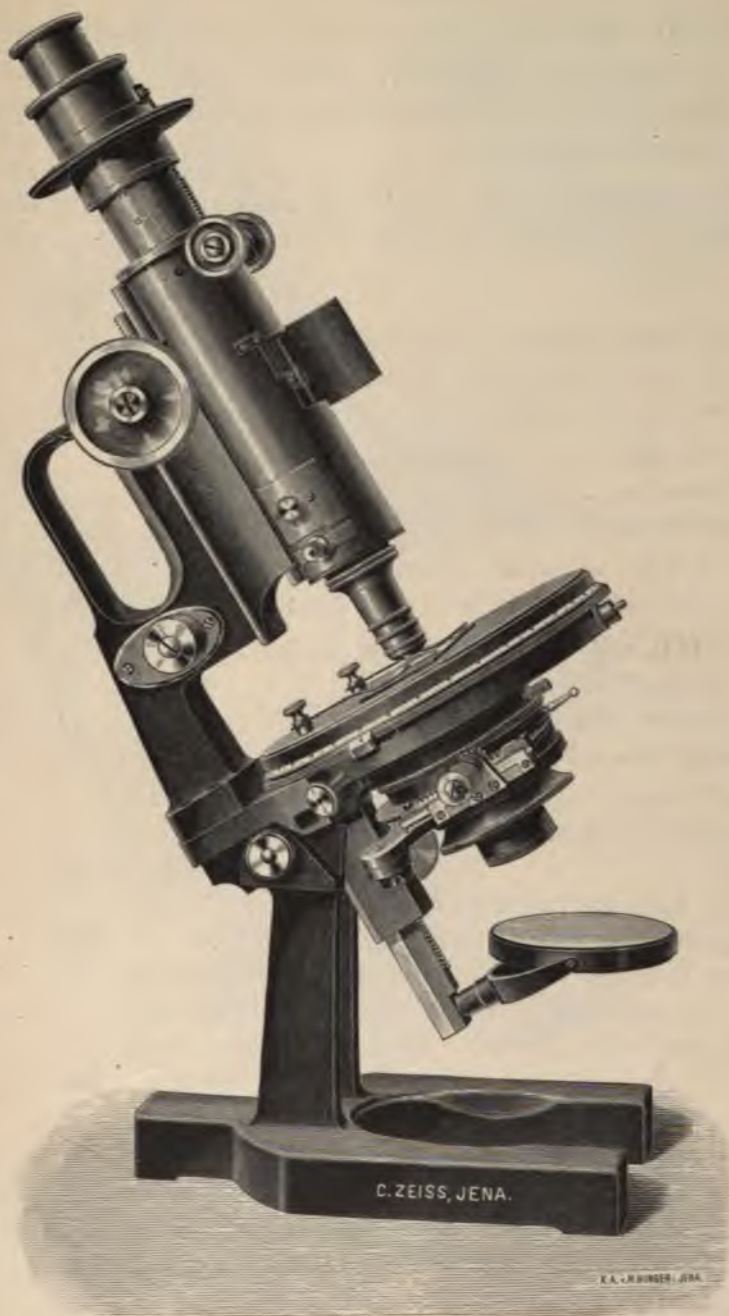
Stand III M can be supplied either with revolving and centring vulcanite stage or the large mechanical stage, both stages being graduated at the circumference and having line index.

No.		*Marks*	*Codeword*
6605	**Stand III** MD with Revolving Vulcanite Stage and ordinary Condenser num. Ap. 1.40	**500.—**	**Paryadres**
6610	**Stand III** MD as above, but with swing-out Condenser num. Ap. 1.40	**525.—**	**Parygrorum**
6705	**Stand III** ME with Large Mechanical Stage and ordinary Condenser num. Ap. 1.40	**575.—**	**Paryphe**
6710	**Stand III** ME as above, but with swing-out Condenser num. Ap. 1.40	**600.—**	**Parysatis**

In the swing-out Condenser num. Ap. 1.40, as supplied for Stand III M, the two upper lenses are easily detached, since their mount, not being attached by screwing, simply slips on above the lowest lens.

To facilitate the employment of Apparatus measuring the angles of axes of crystals, a piece can be inserted between stage and tube-carrier involving an extra cost of 8 Marks. Should this insertion-piece be subsequently required to be adapted, it will be necessary to return the stand to our Works or to one of our Branches.

The compensating ocular 4* and HUYGENIAN ocular 2* can not be used on Stand III M.



163.

Fig. 22.
Stand III MD, No. 6605 with Revolving Vulcanite Stage.
($^1/_2$ Full Size.)

Stand IV.

Upper body with the older form of micrometer movem under part provided, as in **Stand III,** with arrangements for sup menting the stage and illuminating apparatus. In lock-up ished alder-wood cabinet.

We supply **Stand IV,** but very recently introduced, which replaces the **Stan IIa, IVa** and **IVb** of our former catalogues, in the following various forms:

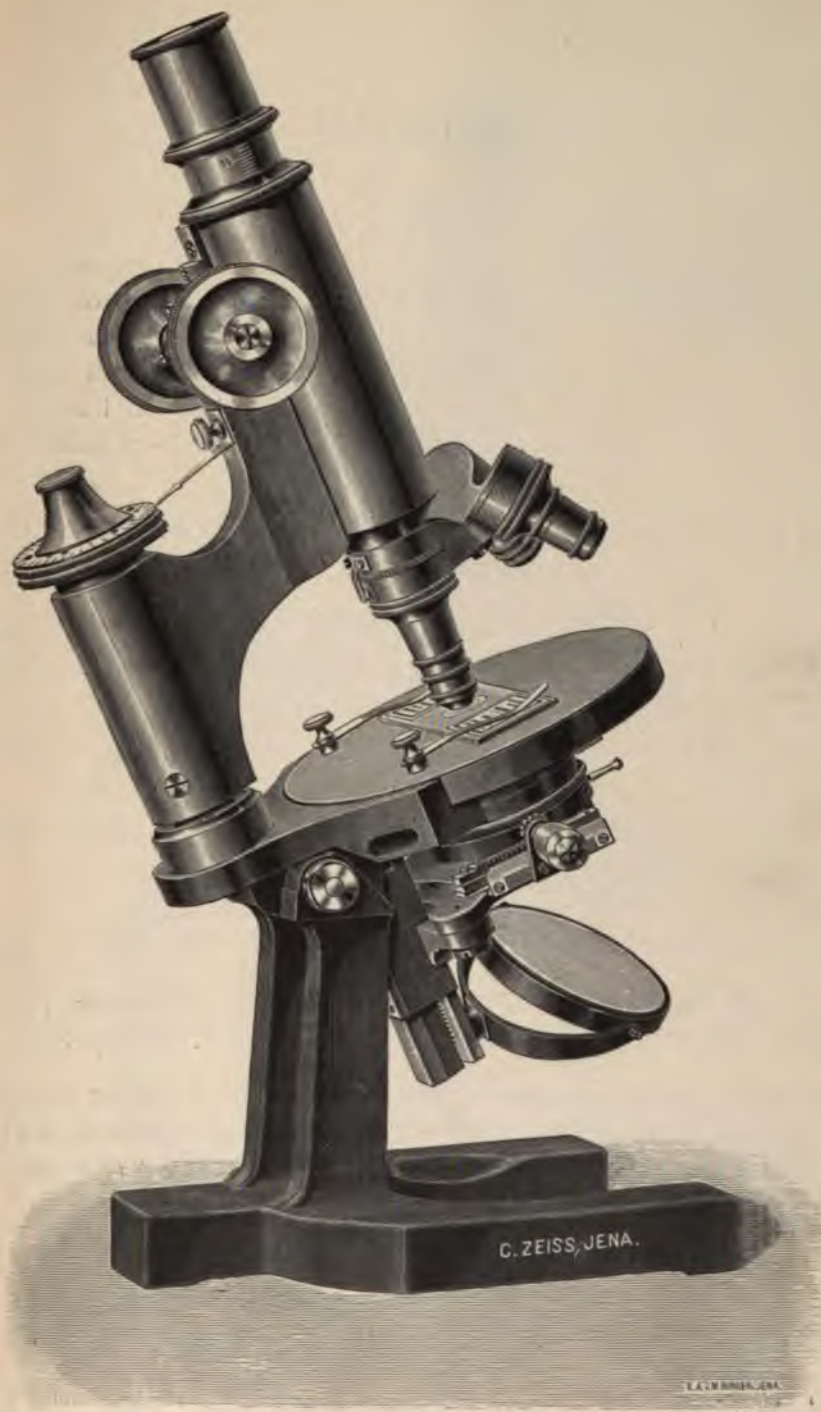
No.		*Marks*	*Code*
6805	**Stand IV** A, with fixed round Stage and Cylinder-diaphragm No. **21**	**180.—**	**Parti**
6905	**Stand IV** B, with fixed round Stage as in **IV** A, ordinary Condenser num. Ap. 1.20 with Iris-diaphragm	**210.—**	**Parti**
	To **IV** A and **IV** B can afterwards be added to supplement the Illuminating Apparatus:		
	The Diaphragm-carrier No. 6220	**20.—**	**Paru**
7005	**Stand IV** C, with Stage as in **IV** A, complete ABBE Illuminating Apparatus with ordinary Condenser num. Ap. 1.20	**225.—**	**Parti**
	To **IV** A, **IV** B and **IV** C can afterwards be added to supplement the Stage:		
	Revolving Vulcanite Stage, No. **6320**	**42.—**	**Parv**
	Large Mechanical Stage, No. **6330**	**117.—**	**Parvi**
7105	**Stand IV** D, with centring and revolving Vulcanite Stage No. **6320,** ABBE Illuminating Apparatus with ordinary Condenser num. Ap. 1.20.	**260.—**	**Parti**
7205	**Stand IV** E, with Large Mechanical Stage No. **6330,** ABBE Illuminating Apparatus with ordinary Condenser num. Ap. 1.20 . .	**335.—**	**Parti**
7305	**Stand IV** F, with revolving, but non-centring, Stage with graduated edge, centring arrangement on the tube, ABBE Illuminating Apparatus with ordinary Condenser num. Ap. 1.20, Polariser **I,** Analyser **I,** Selenite Film for Red of the I. Order No. **180** .	**295.—**	**Parti**

Stand IV F is particularly suitable for histological investigations with ised light.

Should a swing-out Condenser be desired instead of the ordi Condenser the price of the Stand is ***increased by 25 Marks.***

The substitution of a Mahogany Cabinet for that of Al wood raises the price by 20 Marks.

Should a large number of Microscopes be ordered togethe can, if desired, also supply Stand IV without the Alder-wood Ca ets but in ordinary packing case, whereby the cost of the in idual Stand becomes 20 Marks cheaper.



161.

Fig. 23.
Stand IV C, No. 7005.
($^1/_2$ Full Size.)

Small Stands.

Stand V.

Upper body with older form of micrometer movement, the head of the micrometer screw is not provided with graduations; the round stage has a diameter of 11 cm. Stand **V** does not allow of the complete ABBE Illuminating Apparatus being adopted, but on the other hand various condensers with centrally fitted Iris-diaphragm, as well as a Polariser may be inserted into the sliding sleeve of the stage. The stand can not be inclined. In lock-up polished alder-wood cabinet.

Stand V, introduced by us in 1904 and especially designed for laboratory use, is supplied in the following various forms:

	Marks	*Codeword*
Stand V A, with fixed stage and cylinder diaphragm No. **21** . .	**100.—**	**Pasacalle**
Stand V B, with fixed stage, simplified illuminating apparatus No. **3805** with condenser num. Ap. 1.0	**120.—**	**Pasaderas**
Stand V C, with fixed stage, simplified illuminating apparatus No. **37** with condenser num. Ap. 1.20	**126.—**	**Pasados**
Stand V D, with revolving stage provided with graduations at the margin, objective centring appliance on the tube, Polariser **II**, Analyser **I** and Selenite plate for Red of the I. Order No. **182**	**170.—**	**Pasajuego**

If the **Iris-diaphragm** No. **3810**, to be inserted above the Polariser in **Stand V** D, be desired the price is augmented by 8 Marks. (See p. 33.)

Should a large number of Microscopes be ordered together we can, if desired, also supply Stand V without the Alder-wood Cabinets but in ordinary packing case, whereby the cost of the individual stand becomes 12 Marks cheaper.

Stand VI^a.

This stand has a fixed stage 80 mm ($3^1/_8$ ins.) square. The upper body is inclinable as far as the horizontal position. It is supplied with the older form of fine adjustment only, the head of micrometer-screw is not provided with graduations. In lock-up mahogany cabinet.

Fig. 28.
Stand V a, No. 7466.
(1/5 Full Size)

The illumination is obtained by means of the universally movable mirror. The sliding sleeve fixed below the stage by a bayonet joint is not only adapted for the cylinder-diaphragm, No. **39**, and the iris-cylinder diaphragm, No. **40**, but also the illuminating apparatus, No. **41** (see p. 34), may be inserted.

Owing to its compactness **Stand VI^a** is particulary suitable for a **Travelling Microscope.**

We supply the stand, if specially ordered, enclosed in a **small leather or canvas case with shoulder-sling** instead of the mahogany cabinet. The **total weight of the stand with complete optical equipment** (3 objectives, 3 oculars) and the most indispensable specimen utensils, also **including the case,** amounts to **4 kg** (about **9** lbs.).

	Marks	*Codeword*
Stand VI^a with cylinder-diaphragm No. **39**	**130.—**	**Pasage**
„ with iris-cylinder diaphragm No. **40**	**136.—**	**Pasamano**
„ with illuminating system No. **41**	**150.—**	**Pasapan**
Travelling Microscope, Stand VI^a, with illuminating system No. **41, in leather or canvas case with shoulder-sling** . .	**165.—**	**Pasaporte**

Stand IX.

This stand serves as a useful **auxiliary stand for the laboratory, as well as for technical purposes,** especially for the **detection of trichinae.** The round stage has a diameter of 100 mm and a large stage opening of 33 mm which may be reduced by means of the stage diaphragm. The plane and concave mirror is universally movable. In lock-up polished cabinet.

Stand **IX** possesses **only coarse adjustment by means of rack and pinion,** which permits the use of medium power objectives up to 0.65 num. Ap. Fig. 27, p. 59.

	Marks	*Codeword*
Stand IX in case	**50.—**	**Pasqualina**

Stand IX is also suitable for the investigation of opaque objects, rock, metal surfaces and the like, under lower power magnifications when employing the Vertical Illuminator. Regarding the use of the Vertical Illuminator, see pp. 34 and 35.

Fig. 35.
Stand Wa, No. 82.
(½ Full Size.)

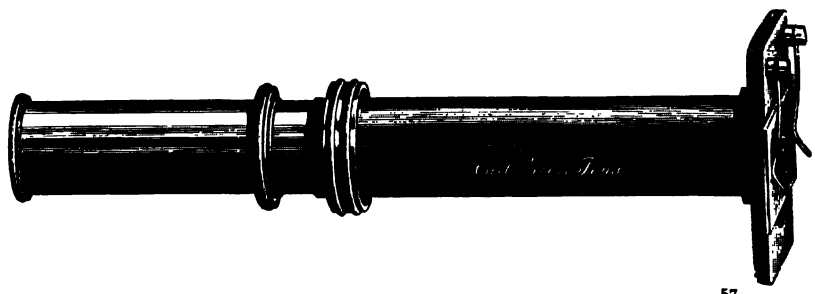
For the particular purpose of **detecting Trichinae** we supply **Stand IX** specially constructed triple or double-lens objectives, so that by unscrewing or two lenses various magnifications result. The two equipments, mainly suffi for the above purpose, are as follows:

No.		*Marks*	*Codeu*
9205	**Microscope for detecting trichinae I,** with triple-lens objective and two oculars, resulting in six various magnifications between about 30 and 190 diameters	**80.—**	**Pastaf**
9210	**Microscope for detecting trichinae II,** with double-lens objective and one ocular, resulting in magnifications about 40 and 100 diameters	**65.—**	**Pastel**

Both instruments satisfy the enactments in force for the German En with regard to the inspection of carcases. No. **9205** has been specially re mended by Prof. JOHNE of Dresden for the equipment of Inspectors for this dis See special prospectus relating to the microscope for the detection of trich

Hand Microscope.

We supply a **Hand Microscope** (Fig. 26) suitable for class demonstr The stage, with clips to hold the specimen, is fixed to the sleeve which rec the body-tube. The instrument is focussed by altering the position of the in the sleeve and after adjustment securing it by a clamping ring. Fine ad ment is effected by drawing the ocular, which fits into the tube with a ce amount of spring, in or out as required. In using the instrument it is dire by hand towards a window or lamp.



57.

Fig. 26. Hand Microscope.
($^1/_2$ Full Size.)

No.		*Marks*	*Codew*
94	**Hand Microscope** without objective or ocular, in case . . .	**15.—**	**Pastil**

Image-erecting Microscopes,
provided with PORRO Prisms.

In the course of 1897 we introduced a new form of **binocular** microscope in which **stereoscopic vision** is obtained, not by division of a pencil of light passing through a **single objective** but by a **combination of two microscopes, complete in themselves and provided with erecting prisms.**

In the Stands **X^a**, **X^b** and **X^c** the **double tube is adjustable by means of rack and pinion.**

The application of erecting oculars fitted with PORRO Prisms affords a convenient means of adjustment for varying inter-pupillary distances. The **paired objectives are mounted upon slides** and require adjusting for each stand separately. ***Consequently it is necessary to send us the tube when subsequently ordering paired objectives.***

The mount of one of the objectives is provided with screw threads to facilitate equally sharp focussing of both lenses in cases where inequalities of power of vision in the two eyes require compensating.

We supply paired objectives for these microscopes in five series (see p. 23), **viz:** (55), (a_0), (a_2), (a_3) and (PI).

The **magnifications** obtainable by combinations of the above objectives and oculars range **between 8 and 72 diameters;** see tables on p. 26, which also contain data of free working distances and of diameters of the visible areas of objects.

It should be observed, that the objective (PI) can only be used as a water immersion system. **(See p. 21.)**

The movement of the casings of the PORRO Prisms is sufficient to admit of adjustment for any inter-pupillary distance within normal limits (56—76 mm $=2^1/_4$—3 in.). In cases where the eyes are abnormally far apart or close together the actual measurements should be specified when ordering.

Fig. 28.

a: **Stand Xs, No. 35.** (1/3 Full Size.)

b: **Upper body of Stand Xs (as a "Dermatoscope", No. 3520) with vulcanite fork attached.** (1/3 Full Size.)

Stand X^a.

The upper body with the double tube is removable. Fig. 28, p. 61. The stage forms a square with sides of 100 mm (4 in.) and has an opening of 33 mm ($1\,^5/_{16}$ in.) diameter. Hand-rests may be attached at both sides of the stage and are always supplied with each stand. After removing the upper body a **vulcanite fork,** which accompanies Stand X^a, may be screwed on to the body-tube carrier in place of the stage. In this form (Fig 28^b) the instrument is available for objects of any shape and may, for instance, be conveniently used as a **"Dermatoscope" for examining the skin** etc., the body carrier being steadied by the hand.

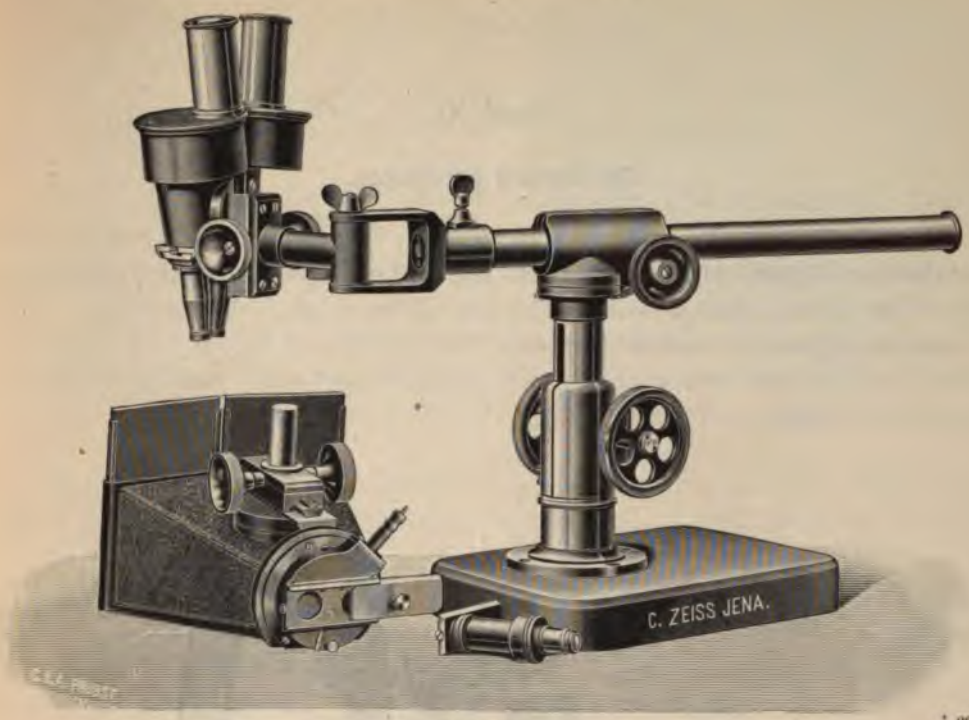
Instead of the tube-carrier illustrated in Fig. 28^a a **straight column** No. **9520** can be attached upright upon the stage, so that a stereoscopic camera may be adapted to Stand X^a; the double tube also of Stand X^b can be employed by means of a column upon the lower part of Stand X^a.

Stand X^b.

This stand, Fig. 29, is primarily designed for the preparation of objects which are too large to be dealt with on the stage of Stand X^a. It is also excellently adapted for **pond-life** studies (whence it may aptly be termed an **Aquarium or Tank Microscope**) and for the observation of portions of large botanical objects, mineralogical specimens, etc., in short, for the microscopical examination of small areas included within more extensive objects which are not to be broken up into smaller fragments. The stand is provided with an extra sliding piece fitted with the "Society" screw which, when in position, closes the opening of one tube. The other tube may then be employed as a monocular microscope, the objective in use having first been exchanged for one of higher power if necessary (see Zeitschr. f. wiss. Mikrosk., vol. XIV, 1897, pp. 5—10).

The stand is mounted on a heavy oblong foot and is fitted with **3 rack-and-pinion and 4 rotary movements.** By the appropriate use of these movements every point of an object, however irregular its outline may be, can be thoroughly examined.

No.		*Marks*	*Codeword*
95	**Stand X^a** with hand-and-arm rests and vulcanite fork . .	195.—	**Pastle**
9510	**Dermatoscope** (upper body of Stand X^a with vulcanite fork)	118.—	**Pastophore**
9520	**Straight Column** for adapting camera No. **9610** or double-tube of Stand X^b upon the lower part of Stand X^a . .	10.—	**Pastoricia**



63.

Fig. 29.
Stand X^b with stereoscopic camera and time and instantaneous shutter.
(1/4 Full Size.)

Should Stand **X^b** *be also required to be used wich transmitted light, the stage No.* ***9605*** *should be added.*

At the suggestion of Dr. DRÜNER we have constructed Stand **X^b** in such a form that a **stereoscopic camera** may be immediately substituted for the double tube. The illustration shows such a camera, with time and instantaneous shutter, lying at the side of the foot of the stand. For particulars of the construction and of the manner of using this camera refer to DRÜNER's "Über Mikrostereoskopie und eine neue vergrössernde Stereoskopcamera" in the Zeitschr. f. wiss. Mikrosk., vol. XVII, 1900, pp. 281—293, as well as our catalogue relating to Micro-photographic Apparatus, 5th Edition, 1903, p. 52.

The illuminating appliance No. 43 (p. 35) can, if desired, be adapted to Stands X^a and X^b; the prices of the Stands being increased by such addition by 36 Marks.

	Marks	*Codeword*
Stand X^b, without stereoscopic camera, in alder-wood cabinet	**260.—**	**Pastoso**
Stage for Stand X^b	**40.—**	**Pastrana**

Stand X^{c}.

The Corneal Microscope.

The double tube is similar to that of the two preceding Stands except that an **illuminating apparatus No. 43 is fitted above the centre line of the microscope** so that the optical axes of both tubes are directed upon the same field. This illuminating apparatus consists of a small incandescent lamp and a duplex illuminator, both resting on slides so as to be adjustable, thus facilitating the best possible lighting of the object.

65.

Fig. 30.
Stand X^{c} No. 98, with EVERSBUSCH's sole-plate and chin-rest No. 9820.
($^{1}/_{5}$ Full Size.)

As a rule we supply a small incandescent lamp, using a pressure of 7 or 8 volts with a current of 1 ampère, and 3 spare lamps. For feeding the lamp it is best to use accumulators. If connection be established with an existing electrical supply system, sufficient resistance must be provided.

Small incandescent lamps of 12 volt pressure can also be supplied if desired.

The double tube with its illuminator attachment is movable within the vertical plane by means of a joint which works on a horizontal axis and may be clamped in any desired position, while a vertical axis admits of the opposite movement. The microscope is elevated or depressed by means of rack and pinion and a second similar movement effects changes of position from front to rear.

For fuller details of the construction of this stand see CZAPSKI: *Binokulares Kornealmikroskop,* GRAEFE's *Arch. f. Ophthalm., vol. XLVIII, 1899, pp. 229—235.*

From a suggestion of Prof. GULLSTRAND we provide, when requested, Stand **X**^{c} with an arrangement for illuminating the object laterally, No. **9810**; for this purpose the illuminating apparatus No. **43** is made slidable in an arc. The price of the stand with this adaption is increased by **30** Marks.

Subsequent transformation of Stand **X**^{c} *No. 98 is possible so as to embody* GULLSTRAND's *device for lateral illumination; it entails, however, the simultaneous ordering of a new cabinet, costing 22 Marks, since any alteration of the stand will not allow its further accommodation in the cabinet previously supplied with the simple Stand* **X**^{c}.

Stand **X**^{c} resting upon a massive tripod foot is most advantageously employed when set upon the **sole-plate with chin-rest** No **9820.** At the suggestion of Prof. EVERSBUSCH this sole-plate is made so as to be movable in two directions at right angles to each other. The sole-plate with chin-rest can also be employed with Stand **X**^{c} No. **9810** as with Stand **X**^{c} No. **98.**

	Marks	*Codeword*
Stand X^{c} (Corneal Microscope) with fixed illuminating apparatus, in alder-wood cabinet	**220.—**	**Patache**
Stand X^{c} with GULLSTRAND's device for lateral illumination in alder-wood cabinet	**250.—**	**Patagino**
EVERSBUSCH's **Sole-plate and Chin-rest** for Nos. **98** and **9810**	**45.—**	**Patamar**

Stand XI.

Monocular image-erecting prism microscope.

Stand **XI** introduced by us two years ago is particularly suitable for use with the Objective **a***. To utilise this system to fullest advantage, the stand has been constructed to allow an object distance of over 10 cm (4 in.) Stage opening and mirror have been designed correspondingly large. The stage, 10 cm square, has an opening 4 cm ($1^1/_2$ in.) diameter, which can be reduced to one of 2 cm by means of a stage diaphragm. The universally movable plane and concave mirror is of 7 cm ($2^3/_4$ in.) diameter. The under part is for the rest similarly constructed as that of Stand **X**^{a}. Fig. 31.

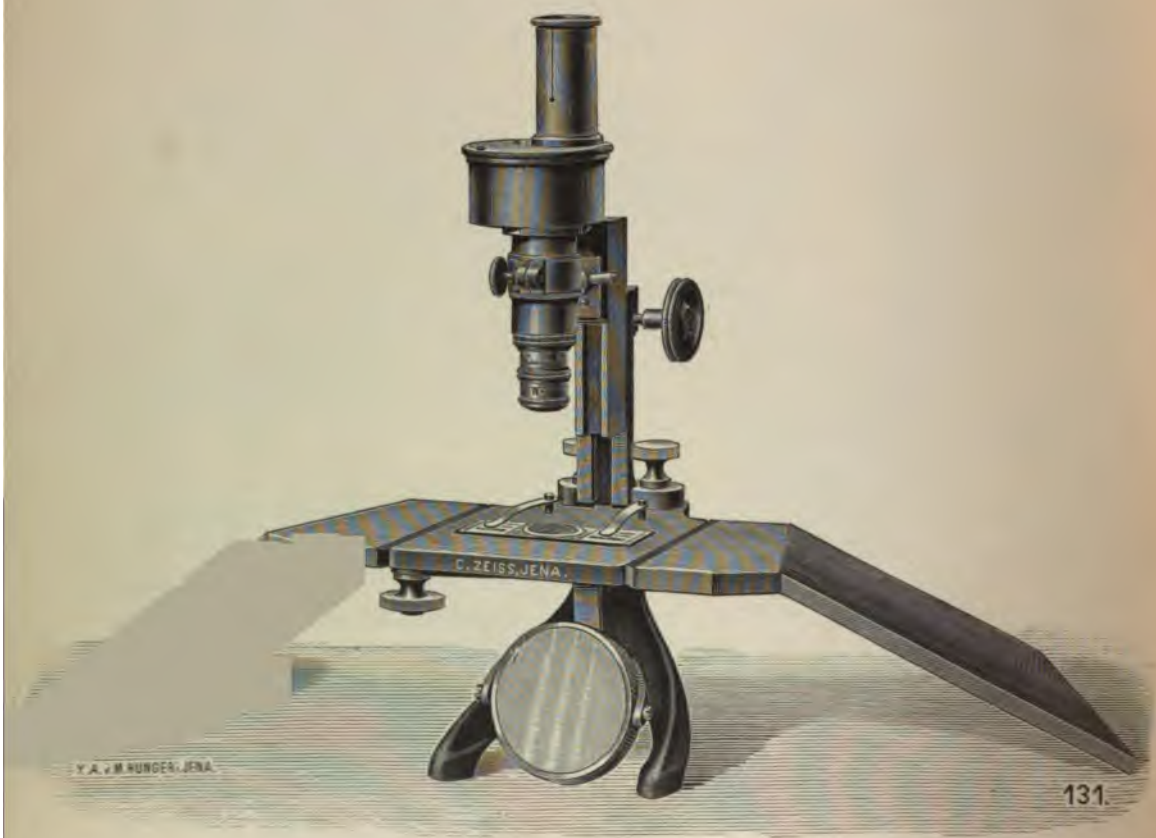


Fig. 31.
Monocular Prism Microscope. ($^1/_3$ Full Size.)

No.		*Marks*	*Codeword*
9905	**Stand XI,** Prism Microscope in alder-wood cabinet	140.—	**Pataraffe**

The arm carrying the tube can be moved up and down in two different ways; first, in the ordinary manner by rack and pinion, second, by moving a slide (carrying the tube along with it) in a dovetail-formed groove. To clamp the slide a short lever is provided.

The body-tube is provided with an image-erecting PORRO prism-system. The lower end of the tube carries the standard thread; an intermediate ring, 15 mm ($^9/_{16}$ in.) in length, accompanies each stand, in order to be able to use the higher power objectives even without nose-piece. The employment of the nose-piece is, however, to be recommended, since it permits the rapid change from teasing out and dissection of specimens with low magnifications to observation with higher magnifications. The intermediate ring should be removed before attaching the nose-piece.

Respecting details of construction, see: P. CULMANN, Monokulares bildaufrichtendes Prismenmikroskop, Zeitschr. f. wiss. Mikrosk. XX, 1903, pp. 416—420.

The lower and medium power objectives to **D** can be used on Stand **XI**; the systems a_0 and a_1, are supplied in a special mount when used with this stand. A still lower power, 55 mm ($2^1/_8$ in.) focal length, costing **15** Marks (*Codeword:* **Pataroxa**), is likewise suitable.

Our Drawing Apparatus No. 109—112 can be attached to this just as to our other monocular stands.

Stand P II.

Drawing Apparatus for low magnifications.

This stand is intended not only for the observation and dissection of large objects but also to afford facilities for drawing an extensive specimen upon any desired scale within wide limits.

Two horizontal arms may be moved by rack and pinion up or down the massive brass column situated on the left. The upper one has a hole bored into its outer extremity for the insertion of various holders for spectacle-lenses, magnifiers and for an **erecting microscope**; the lower arm carries a **stage frame** into which a plate of glass, metal or wood may be inserted. Fig. 32, p. 68.

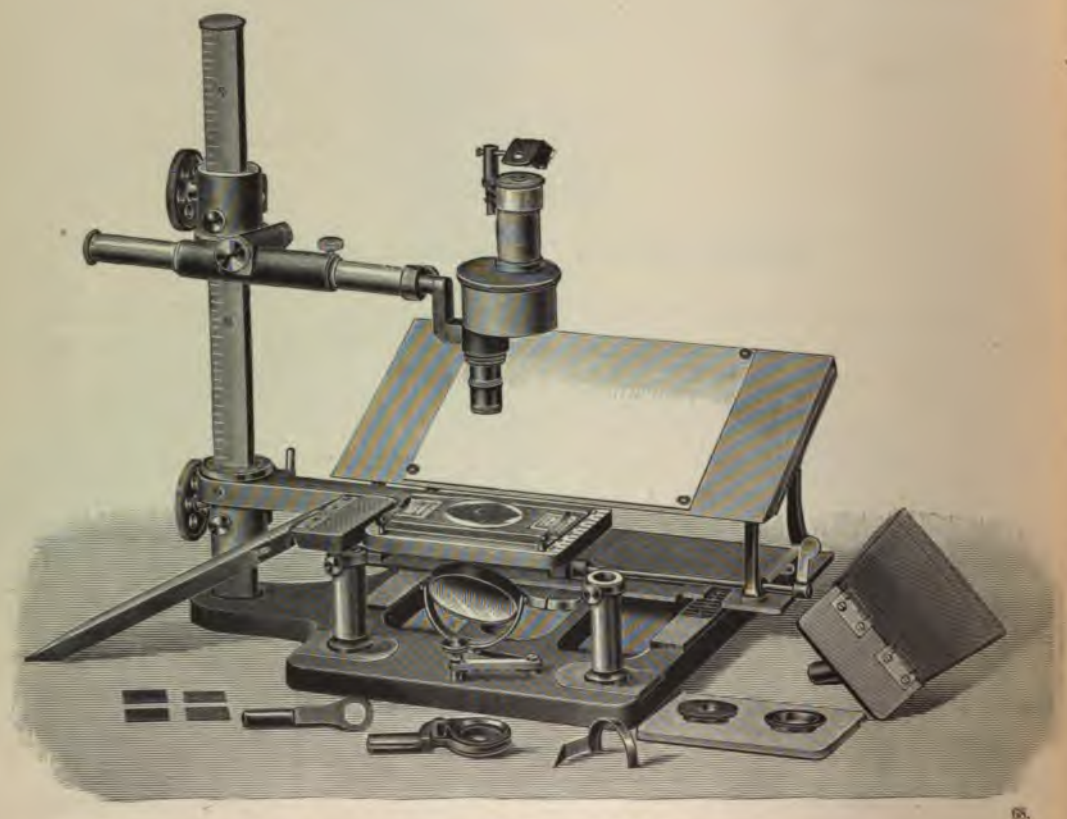
	Marks	*Codeword*
Stand P II (Drawing apparatus for low magnifications) in alder-wood cabinet. Without optical equipment	**260.–**	**Patesea**
Stand P II with drum containing PORRO prism-system, objective **a***, HUYGENIAN oculars **2** and **4**, magnifiers Nos. **9** and **10**, 4 spectacle-lenses, drawing prism No. **109**	**410.–**	**Patiojo**

With transmitted light the illumination is provided by a mirror with universal motions which is inserted into the base-plate or, with very low magnifications, simply by means of a sheet of white paper.

The **drawing prism, No. 109,** slips over the ocular, but if it is to be used in conjunction with magnifiers or spectacle-lenses, it is fixed to the sides of their holders.

The **drawing board** rests upon a frame resembling a desk on the face of which it slides up or down at an inclination of 25°. The frame itself slides backward and forward in the groove of the base-plate.

Scales engraved on both sides of the stage in conjunction with a scale on the base-plate serve to ensure **an equal magnification being maintained throughout the process of drawing selected portions of a large object.**



68.

Fig. 32. Stand P II, Drawing Apparatus for low magnifications.
($^1/_5$ Full Size.)

The apparatus can also be used for drawing on a **reduced scale** by placing the object upon the drawing-board and the paper upon the wooden plate of the stage.

Objective a* with variable initial magnification is the most suitable lens for drawing with the microscope although other objectives of low and medium power, to perhaps **C**, may still be used with a fair degree of convenience. The combination of **a*** with HUYGENIAN oculars Nos. **1—5** results in almost any desired magnification, ranging between × 2.25 and × 23, being obtained, while the diameter of the visual field varies between about 6 and 45 mm ($^1/_4$ and $1^3/_4$ in.). Spectacle-lenses of from 1 to 5 diopters yield magnifications from 1.25 to 2.25 diameters. For details in construction we must refer to: M. BERGER, Zeitschr. f. Instrkde. XXI, 1901, pp. 171—175.

Cabinets for the Stands.

The cabinets and cases for the storage and transport of the stands are reduced as much as possible for the sake of compactness, yet sufficient room is provided for the entire instrument with its objectives (even when attached to revolving nose-pieces or sliding changers) and inserted ocular, and for a sufficient number of objectives, oculars and some few accessory appliances. (See Fig. 45, p. 96.)

The price of the cabinet or case is always included in that of the stand.

Leather travelling-cases for the protection of the cabinets are regularly manufactured by us in two various sizes.

	Marks	*Codeword*
Leather travelling-cases for cabinets of Stands I, III, IV . . .	**36.—**	**Patrissabo**
„ „ „ „ „ **Stand VI[a]**	**28.—**	**Patrizzavi**

If desired, the **owner's name may be engraved** upon the base of the stand. Charge for engraving name on stand: Marks 3.—. (*Codeword:* **Patriota.**)

Nickelled name plates for the mahogany cabinets are also supplied. Price of nickelled plate, including engraving of name: Marks 5.—. (*Codeword:* **Patricio.**)

Accessory Apparatus.

A. Drawing Apparatus.

The drawing surface in all drawing apparatus of our make is rendered visible by double reflection, while the pencils of rays emerging from the microscopes or magnifiers reach the eye by a direct path.

In addition to the old form of **"Camera lucida"** — the **drawing prism, No. 109**, shown in Fig. 33 and introduced by us in 1869 — the **drawing apparatus designed by Professor ABBE** has been supplied by us for about the last 20 years.

*For a special **Drawing Apparatus for low magnifications** see pp. 67—69.*

While in the drawing prism, as also in most other existing forms of drawing apparatus, only a semi-circular portion of the exit pupil can be utilised, in the ABBE drawing camera the full area of the pencil is effective. Loss of light is therefore avoided even when using the highest magnification, while both the pencil and the drawing surface remain quite clearly visible. This material advantage is gained by the application of a small cube, composed of two equal rectangular prisms cemented together — the **"ABBE cube"** — in the position of the eye-point of the ocular. The cemented surface of the upper prism is silvered but has a central aperture of 1 or 2 mm diameter.

The **brightness of the drawing surface and of the image can be modified** in all our drawing apparatus by the **interposition of smoked glasses.** With drawing prism, No. **109**, as also with the small ABBE drawing apparatus, No. **110**, one or two smoked glasses may be inserted into the prism casing. The brightness of the image may be moderated in either of two ways, i. e., by appropriate stopping or by the use of smoked glasses in connection with the illuminating source.

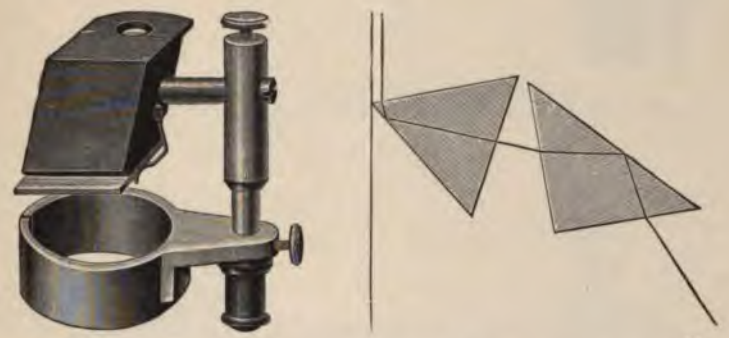
For the purpose indicated above the large ABBE drawing apparatus, Nos. **111** and **112**, are fitted with a cap encasing the prisms from above, which is provided with moderating glasses of varying degrees of illumination, and with a similarly equipped eccentric disc pivoted below the prisms. In both appliances only five of the six openings contain smoked glass, the sixth remaining clear so that the cap and disc may remain

attached although the brightness of the image or of the drawing surface may not require moderating.

In order to enable the somewhat large exit pupil of the microscope obtained with low magnifications being fully utilised, the usual ABBE cube with aperture of 1 mm can, with the two large drawing apparatus, quickly and conveniently be exchanged for another of 2 mm aperture.

Glasses to correct defects of vision are, if required, supplied with our drawing apparatus.

No. **109**. ***Old form of Camera lucida.** This drawing prism is only supplied in the form shown in Fig. 33. The prism casing turns round a horizontal axis and is also adjustable in elevation. It is attached to the tube by means of a sprung collar and can easily be turned aside.



75.

Fig. 33. Drawing Prism (Camera lucida) No. 109. ($^3/_4$ and $^2/_1$ Full Size.)

On the Drawing Apparatus for low magnifications (Stand PII), No. **102** can only the drawing prism No. **109** be used. For the arrangement of this apparatus, which can be equipped at the same time with an image-erecting microscope, see pp. 67—69.

The ABBE **drawing cameras** are constructed in three different forms:

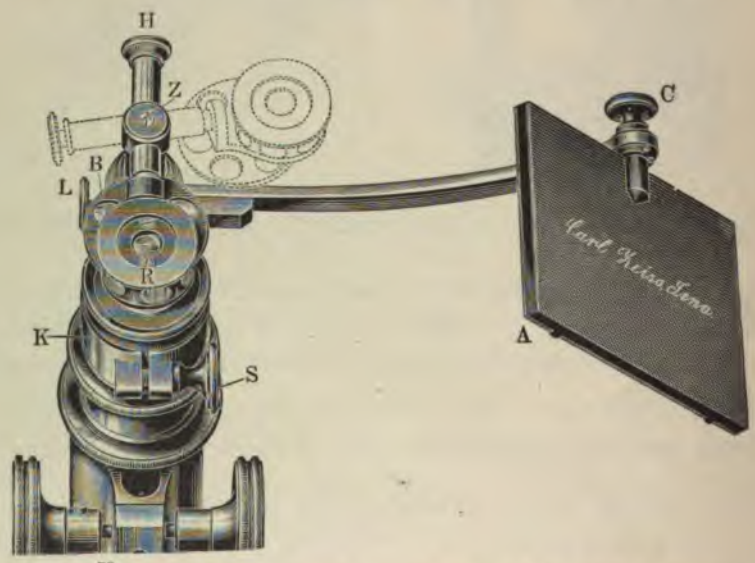
No. **110**. ***Small ABBE Drawing Apparatus.** The prism casing and the mirror — the latter supported by an extended arm about 105 mm (4 in.) long — are connected with the clamping ring by hinges. The size of the mirror is 50 × 75 mm (2 × 3 in.). The clamping ring is attached to the draw-tube before putting on the ocular. The upper parts — prism casing and mirror — can be

	Marks	*Codeword*
Drawing Prism (Camera lucida), in case	**21.—**	**Patron**
Small ABBE Drawing Apparatus, in case	**30.—**	**Patronato**

turned back on their hinges so as to enable the object being viewed direct instead of through the prism. The ABBE cube and other parts always return to exactly the same position on being closed down again.

77.

Fig. 34. Small ABBE Drawing Apparatus, No. 110. (3/5 Full Size.)



78.

Fig. 35. Large ABBE Drawing Apparatus, No. 111. (3/5 Full Size.)

No. **111. *Large ABBE Drawing Apparatus.** After removing the ocular the clamping ring of the drawing apparatus is slipped over the tube and

No.		*Marks*	*Codeword*
111	**Large ABBE Drawing Apparatus,** in case	**60.—**	**Patudo**

fastened by tightening the screw *S*. By altering the position of the clamping ring the aperture in the silvered prism may be brought to the same height with the exit pupil of the microscope. The screws *L* and *H* (Fig. 35) serve to facilitate the accurate centring of the prism. (See Zeitschr. f. wiss. Mikrosk., vol. XI, 1894, pp. 289—298, as well as the directions for use accompanying each ABBE drawing apparatus.)

The length of the supporting arm and the size of the mirror are the same as with the preceding apparatus. The casing, together with the prism and the moderating glasses, may be turned aside about the pin *Z* into the position indicated by the dotted lines in Fig. 35.

No. **112.** ***Large ABBE Drawing Apparatus.** This form of the apparatus is **adapted for the oculars with enlarged field of view** but it can also be used with ordinary oculars. The length of the arm supporting the mirror is 125 mm (5 in.), the size of the mirror 80 × 125 mm ($3^1/_8$ × 5 in.).

Drawing Tables and Boards.

In order to obtain copies of objects free from distortion and with a field of view of fair size, it is advisable to use a support for the drawing paper, inclined at the proper angle. We supply various patterns of drawing tables and boards suitable for this purpose.

Nos. **113** and **114.** The two forms of ***BERNHARD's Drawing Tables** satisfy in a perfect manner the twofold requirement of being adapted for regulating the height of the drawing surface above the work table and for varying its degree of inclination to the horizontal plane. (See Zeitschr. f. wiss. Mikrosk., vol. IX, 1892, pp. 439—445, and vol. XI, 1894, pp. 298—301.)

With tables of above pattern the drawing surface may be raised to a height of 17 cm ($6^3/_4$ in.) and inclined at an angle of about 35°. The microscope is clamped to the base of the drawing table, and arm-rests are provided in order to give the operator's hands the steadiest possible position.

	Marks	*Codeword*
Large ABBE Drawing Apparatus (for oculars with enlarged field of view), in case	**72.—**	**Paulatino**
BERNHARD'S Drawing Table, for use with erect Microscope	**45.—**	**Pausado**
BERNHARD'S Drawing Table, for use with inclined Microscope	**52.—**	**Pautador**

The table is supplied either for use with the **microscope in the upright position** (No. **113**) or with an **arrangement for inclining** the microscope (No. **114**), together with the table. (Fig. **36**.)

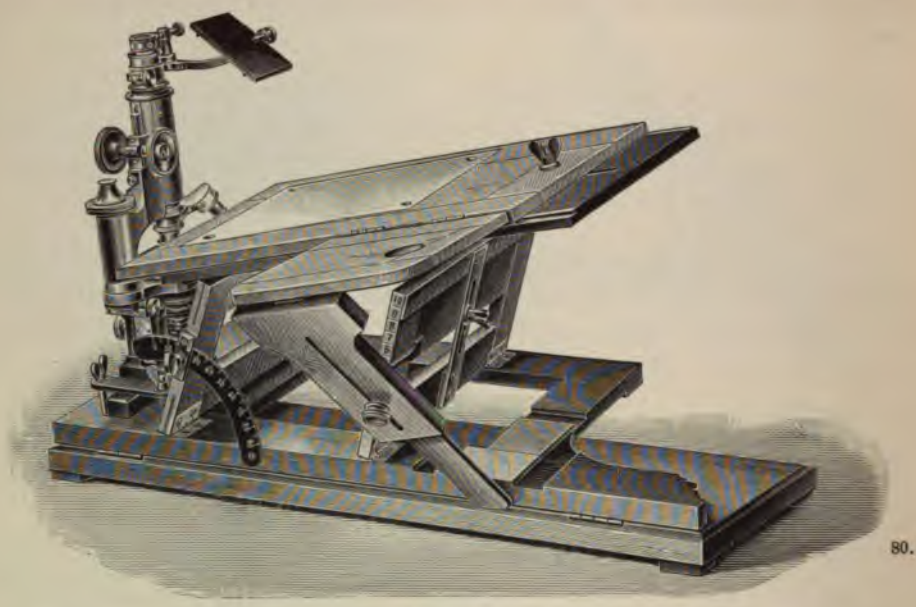


Fig. 36.
BERNHARD's Drawing Table No. 114, in combination with Microscope and Drawing Apparatus.
($^1/_6$ Full Size.)

No. **115.** In addition to above-described two patterns of drawing tables we also supply suitable **lime-wood Drawing Boards,** No. **115,** having the surface inclined at an angle of 25°.

No.		*Marks*	*Codeword*
115	**Simple Drawing Board**	**2.50**	**Pavana**

B. Appliances for measuring and counting microscopic objects.

Measuring Apparatus.

Ocular Micrometers and Stage Micrometers.

The requirements of measuring microscopic objects are in most cases met by the use of simple **ocular micrometers,** i. e., of small glass discs with divisions, which are dropped into the oculars with the side bearing the division lines downwards. The values of divisions are best determined by comparison with a good stage-micrometer for each combination of objective and ocular. Approximate values, which are in many cases sufficiently accurate, will be found in tables supplied with each ocular micrometer. These tables apply to combinations of achromatic objectives with HUYGENIAN oculars, and are calculated for the prescribed (160 mm) tube-length.

In combinations of the compensating oculars **6** with any of the apochromatic objectives the approximate determination of the value of an interval becomes very much simplified. The divisions in this ocular are so computed that with a tube-length of 160 mm the value of one interval of the micrometer scale represents exactly as many micra, μ (0.001 mm), as there are millimetres in the focal length of the objective, i. e., Systems: **16 mm, 8 mm** etc., value of interval: 16 μ, 8 μ etc. (See Zeitschr. f. wiss. Mikrosk., vol. V, 1888, pp. 150—155.)

As however these values also are still only approximate, a comparison must be made with the stage-micrometer whenever more exact measurements are required.

Our regular manufacture of **Ocular Micrometers** is restricted to the one form, catalogued as No. **117 : 5 mm divided in $^1/_{10}$ mm.**

Other divisions to order.

When ordering ocular micrometers please state whether they are required for ordinary or for micrometer oculars.

	Marks	*Codeword*
Ocular Micrometer, in case	**5.—**	**Pavilon**

Two forms of **Stage Micrometers** are regularly supplied:

No. **118: 1 mm divided in 100 parts.**
No. **119: 1 cm divided in millimetres, the last of which in tenths.**

With regard to ocular and stage cross-line micrometers refer to p. 80.

82.

Fig. 37.
Micrometer Ocular.
(Full Size.)

Nos. **120—123. Micrometer Oculars.** Oculars with sliding eye-lenses, **"micrometer oculars"**, are constructed for the purpose of facilitating exact adjustment of the micrometer scale to the eyes of individual observers. These are the HUYGENIAN oculars **2** and **3** (No. **120**) for achromatic, and compensating ocular **6** (No. **122**) for apochromatic objectives. The upper part of the ocular-tube is capable of being unscrewed so that the ocular-micrometer can be conveniently laid upon the diaphragm.

By fitting a drum-shaped adapter to these micrometer oculars lateral adjustment of the micrometer scale, or of an index (see under **Index Oculars**, p. 88), becomes also possible. When thus fitted, they are called **"Drum Oculars with Micrometer"** and may also consist of either the HUYGENIAN oculars **2** or **3** (No. **121**) or compensating ocular **6** (No. **123**).

No.		*Marks*	*Codeword*
118	**Stage Micrometer,** in case	**10.—**	**Pavimiento**
119	„ „ „ „	**6.—**	**Pavon**
	Micrometer Oculars for Achromatic Objectives:		
120	HUYGENIAN Ocular **2** or **3** with micrometer . .	**18.—**	**Pavonazo**
121	„ „ „ „ „ „ Drum and Screw for moving the micrometer laterally, called the **"Drum Ocular with Micrometer"**, in case . . .	**40.—**	**Pavorde**
	Micrometer Oculars for Apochromatic Objectives:		
122	Compensating Ocular **6** with micrometer. . .	**31.—**	**Pavura**
123	„ „ „ „ Drum and Screw for moving the micrometer laterally, **"Drum Ocular with Micrometer"**, in case	**53.—**	**Payaso**

No. **124** or **125.** ***Screw Micrometer Ocular.** This apparatus is for performing very exact measurements. It consists of a RAMSDEN ocular of about 20 mm (3/4 in.) focal length — corresponding magnification = 12 diameters — or a suitable compensating ocular and a very carefully constructed micrometer with divided drum. (Fig. 38.) The glass plate, with a crossed as well as a double line, is moved across the field by means of the micrometer screw. Each interval of the divided drum corresponds to a movement of 0.01 mm of the point marked. Complete revolutions of the drum are counted by means of a numbered scale seen in the field. The measurement can be extended over a tract of 4 mm of the objective image.

The absolute values corresponding to the divisions of the drum should be determined by the aid of a stage-micrometer for each separate objective.

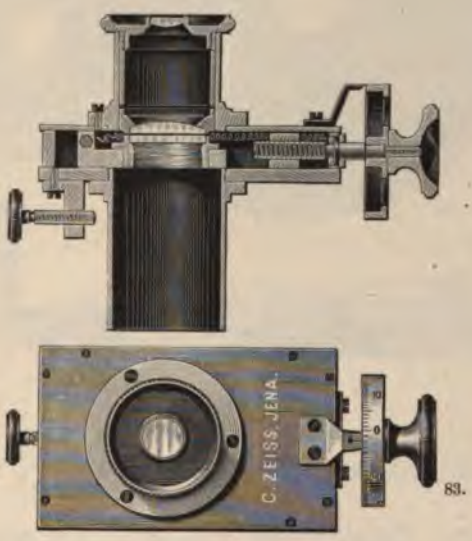


Fig. 38. Screw Micrometer Ocular, No. 124.
Sectional elevation and plan view. (2/3 Full Size.)

		Marks	*Codeword*
4	**Screw Micrometer Ocular** with RAMSDEN ocular for achromatic objectives, in case	**90.—**	**Peal**
5	**Screw Micrometer Ocular** with compensating ocular **6** for apochromatic objectives, in case	**105.—**	**Pebetero**

No. **126.** ***Stage Screw Micrometer.** For the exact measurement of objects too large for inclusion in one visual field of the microscope we construct the **Stage Screw Micrometer.** A slide moved by the micrometer screw carries a rotating disc with divided circle. The divisions of the drum indicate 0.002 mm; complete revolutions of the drum are counted by an index. The screw measures up to 10 mm.

The instrument is adapted for Stands **I, III, IV** *and* **V.** *In subsequent orders the factory number of the stand should be quoted.*

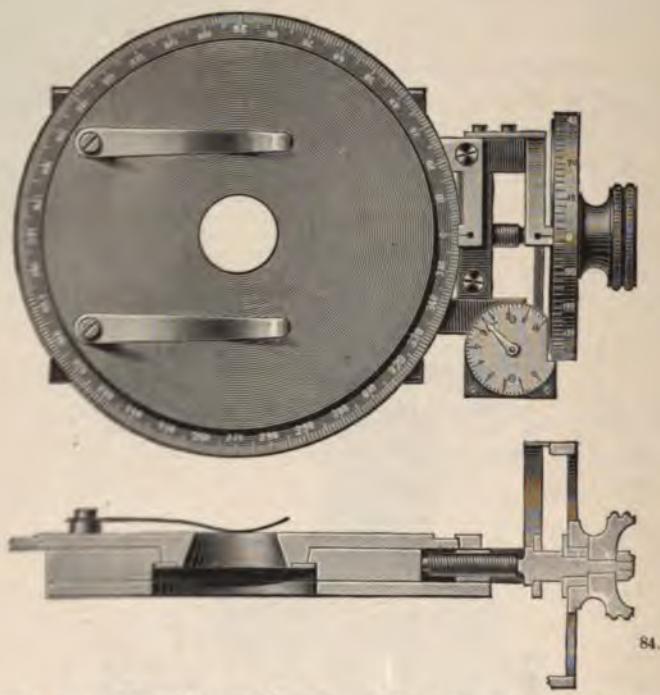


Fig. 29. **Stage Screw Micrometer, No. 126.** (2/3 Full Size.)

Nos. **127** and **128.** **Goniometer Oculars.** For **measuring the angles** of microscopic objects we construct the **Goniometer Oculars,** the former number with HUYGENIAN oculars **2** or **3** (No. **127**), the latter with compensating ocular **4** (No. **128**). The eye-lens is adjustable as with the micrometer oculars. In place of with a series of parallel lines ruled upon it rests upon the diaphragm. An indicator, attached to the upper part of the ocular, moves within a divided circle fixed on the draw-tube.

No.		*Marks*	*Codeword*
126	**Stage Screw Micrometer,** in case	**120.—**	**Pecable**
127	**Goniometer Ocular,** HUYGENIAN ocular **2** or **3**	**35.—**	**Pecante**
128	**Goniometer Ocular,** compensating ocular **4**	**48.—**	**Pecemento**

Appliances for measuring thicknesses.

No. **129. Dial Cover-glass Gauge.** The apparatus serves the purpose of estimating the exact measurement of the thickness of cover-glasses, thin plates, etc. — The measurement is effected by means of a clip projecting from a box-shaped round casing. The reading is given by an indicator moving over a divided circle on the lid of the box. The divisions show hundredths of a millimetre. The gauge measures thicknesses up to 8 mm.

No. **130. Cover-glass Gauge of simpler construction.** This instrument consists mainly of a screw with divided drum and, like the preceding, records readings of 0.01 mm.

Measuring Scales and fully divided Circles.

Nos. **131** to **139.** We are prepared to supply **measuring scales on nickel-silver or plate-glass** in any form desired. The following are a few patterns regularly stocked by us:

The nickel-silver rules have bevelled edges. In rules on plate-glass and in the fully divided circles the figures are in mirror-type so that the divisions may be laid on the surface of objects to be measured and be easily read off without parallax.

›.		*Marks*	*Codeword*
9	**Dial Cover-glass Gauge**	30.—	**Pecora**
0	**Cover-glass Gauge,** simpler construction.	15.—	**Pectoral**
1	**Nickel-silver Rule.** 10 cm divided in millimetres	4.—	**Pecunia**
	Rules on Plate-glass with simple ruling:		
2	5 cm divided in $^1/_2$ millimetres.	3.—	**Pedaceria**
3	10 „ „ „ millimetres	4.—	**Pedagogo**
4	20 „ „ „ „	8.—	**Pedano**
5	30 „ „ „ „	12.—	**Pedestal**
	Rules on Plate-glass, double scale (one side in millimetres, the other in inches):		
6	5 cm in half millimetres (2 ins. in 48 parts)	4.50	**Pedido**
7	10 cm in whole millimetres (4 ins. in 48 parts) . . .	6.—	**Pediluvio**
	Fully divided Circles on Plate-glass:		
8	Circle of 80 mm diameter divided in degrees . . .	14.—	**Pedometro**
9	„ „ 120 „ „ „ „ half degrees. .	20.—	**Pedrada**

Appliances for Counting.

Cross-line Micrometers are usually employed for counting small objects, such as blood-corpuscles, yeast-cells, bacteria, etc.

No. **140. Ocular Cross-line Micrometer.** We supply this micrometer to rest on the diaphragm of the ocular or, preferably, for use with a micrometer ocular having an adjustable eye-lens. The division embraces a square of 5 mm, divided into squares of 1.0 or 0.5 mm, as may be desired.

When ordering please state whether the micrometer scale is required for an ordinary or for a micrometer ocular.

No. **141. P. EHRLICH's Ocular-diaphragms** may be used for counting the number of corpuscles within a field of known area, in a similar manner as the ocular cross-line micrometers. These diaphragms are provided with square openings and are supplied in assorted sets having squares of 1, 2, 3, 4, 6, 8 and 10 mm.

In the case of ocular cross-line micrometers as well as EHRLICH's diaphragms — unless the latter are merely intended for verification of the quantities within the same area — it is necessary for each combination of objective and ocular to ascertain, by means of stage micrometers, the actual surface values corresponding to the various fields.

EHRLICH's diaphragms being primarily designed for use in conjunction with micrometer oculars (see p. 76), it should be expressly stated when ordering them if they are to be used with other types of oculars.

No. **142. Cross-line Stage Micrometers** are, as a rule, supplied only in connection with the appliance known as the ***Counting Chamber.** This latter consists of a cell of exact and uniform depth of 0.1 mm, the bottom of which is ruled in squares. The most commonly used form of such chamber (THOMA's) — No. **142** — contains 400 squares, each having an area of $^1/_{400}$ square millimetre.

Two cover-glasses, plane-polished, of 0.4 mm and 0.6 mm, accompany each counting chamber.

No.		*Marks*	*Codeword*
140	**Ocular Cross-line Micrometer.** in case	5.—	**Pedregoso**
141	**P. EHRLICH's Ocular-diaphragms.** 7 pieces in all	10.—	**Pedril**
142	***Counting Chamber (Cross-line Stage Micrometer)** with 2 cover-glasses, in case	15.—	**Pedro**

Besides the counting chamber No. **142** we supply various other counting chambers as well as accurately calibrated mixing pipettes for diluting blood and the like.

No. **149. Blood-counting Apparatus,** consisting of a counting chamber and one or two accurately calibrated **mixing pipettes,** is likewise supplied in various combinations. THOMA's **Haemocytometer,** No. **149,** supplied with one mixing pipette for red corpuscles and another for the white, is the most frequently used apparatus of this kind.

Further information regarding the variety of forms of the divisions of squares in our counting chambers, the various classes of mixing pipettes and complete counting apparatus are contained in a separate pamphlet dealing with blood-counting apparatus (M 10), copies of which may be obtained on application.

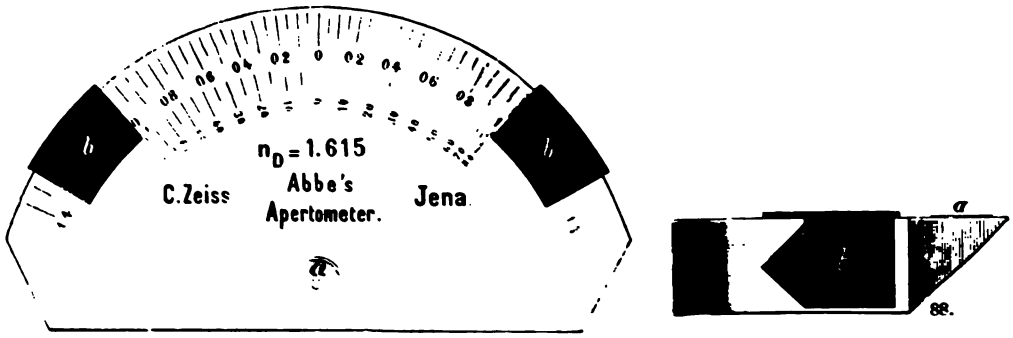
	Marks	*Codeword*
THOMA's Haemocytometer (Blood-counting Apparatus), No. **142**, with 2 mixing pipettes, in case	**30.—**	**Peirayo**

C. *Apertometer, *Test-plate, *Diffraction Apparatus.

Nos. **155** and **156. Apertometer.** A simple apparatus for determining the numerical and angular aperture of objectives, the **Apertometer,** was designed by Professor ABBE in 1876. It is adapted for any large or medium stand fitted with a draw-tube. A low-power objective of about 40 mm focal length, which screws into the lower extremity of the draw-tube, is supplied with the instrument, but under appropriate stopping the BERTRAND lens may, with Mineralogical Stand **III** M, be used instead. The auxiliary microscope, formed by the combination of the low-power objective with the ocular, being focussed upon the exit pupil of the objective to be examined, the numerical aperture of the latter may be read off from the apertometer by means of two movable metal indicators.

Further particulars regarding principles of construction of the apparatus and the method of measuring with it are contained in the Journ. of the R. Micr. Soc. (1), vol. I, 1878, pp. 19—22, and (1), vol. III, 1880, pp. 20—31; E. ABBE, Gesamm. Abhandl. I, 1904, pp. 113—118 and pp. 227—243; see also DIPPEL, "Das Mikroskop", vol. I, pp. 348—352.

We supply **two different patterns of the apertometer;** in the form (No. 155) shown in Fig. 40 the indicators move upon the glass disc direct, whereas in the



View from above. Side view.

Fig. 40.

Apertometer, No. 155.

(Full Size.)

second model No. **156** the glass disc is mounted upon a metal plate with a slot for the more certain and more convenient adjustment of the indicators.

No. **157. Test-plate.** For testing lenses with respect to spherical and chromatic aberrations and for estimating the thickness of the cover-glass, which corresponds to the most perfect correction, a **test-plate** was designed by ABBE in 1873. Used in conjunction with the ABBE Illuminating Apparatus and by establishing the sensitive rays, it gives the greatest prominence to any existing faults of correction.

This test-plate consists of an object carrier with six cover-glasses of accurately determined thickness (0.09 mm to 0.24 mm) cemented side by side. These cover-glasses are silvered on their lower surfaces and engraved with lines, the jagged edges of which form the test-object proper.

See E. ABBE in Archiv f. mikr. Anat. v. IX. 1873, pp. 434—437, Gesammelte Abhandl. I. 1904, pp. 96—98, also DIPPEL, "Das Mikroskop", vol. I, p. 340 and the directions accompanying the test-plate.

No.		Marks	Codeword
155	**ABBE's Apertometer.** In case	**70.—**	**Pelar**
156	**ABBE's Apertometer, with slot-guide for the indicators.** In case	**90.—**	**Pelara**
157	**ABBE's Test-plate.** In case	**10.—**	**Pelender**

No. **158. Diffraction Apparatus.** Constructed by ABBE in 1876 it serves to demonstrate the effects of diffraction in the formation of microscopical images. It consists of a diffraction-plate and a set of stops, with an arrangement for fitting and rotating them above the objective.

***The dimensions of the stops are only adapted for the objective* aa.**

No. **159. Diffraction Plate.** This plate consists of a glass slide with three cover-glasses cemented side by side. The lower surfaces of the latter are silvered and have groups of lines ruled upon them so as to form various simple and crossed gratings.

See Monthly Micr. Journ., vol. XVII, 1877, pp. 82—88; DIPPEL, "Das Mikroskop", vol. I, pp. 147—156; ZIMMERMANN, "Das Mikroskop", Vienna, 1895, pp. 46—51.

D. Appliances for microscopic examination in polarised light.

Nos. **160** and **161. Polarisers.** As a rule we supply **polarisers** with end-surfaces inclined to the optical axis of the microscope. That having an aperture of 10 mm, **Polariser I**, No. **160**, is intended for use with Stands **I**, **III** and **IV**. Selenite and mica films may be placed upon the plate-shaped rim of the mount.

The other form of 8 mm aperture, **Polariser II**, No. **161**, is as a rule supplied only for use with the double-lens condenser system, num. Ap. 1.0 for Stand **V** D.

The iris-diaphragm No. **3810** of the simplified illuminating apparatus No. **3805** (see pp. 33 and 54) can in Stand **V** D be inserted between the condenser system and Polariser II.

In subsequent ordering Polariser II, No. 161, the factory number of the Stand should be stated.

	Marks	*Codeword*
ABBE's Diffraction Apparatus	**20.—**	**Pelele**
„ **Diffraction Plate alone,** in case	**8.—**	**Pelicabra**
Polariser I, for use with Stands **I, III** and **IV**	**22.—**	**Pelicula**
„ **II,** „ „ „ Stand **V** D	**25.—**	**Pelito**

Nos. **162** and **163.** **Analysers.** The **Analysers** supplied by us are, as a rule, prisms of 6 mm aperture with their top and bottom faces at right angles to the microscope axis. The mount of **Analyser I** is so arranged that the prism fits immediately upon the ocular. **Analyser II** is fitted with a divided circle attached to the tube, above which the prism revolves.

Nos. **165** to **168.** ***Abbe's Analyser-Oculars.** In addition to the above we supply the **ABBE Analyser-Oculars.** These consist of an analyser of special construction situated between the lenses of HUYGENIAN ocular **2** (Nos. **165** and **166**) or compensating ocular **4** (Nos. **167** and **168**). The oculars (Nos. **166** and **168**), too, may be fitted with divided circles.

Nos. **169** to **174.** **Combinations of Polariser and Analyser.** For convenient safe-keeping we supply various combinations in special cases.

*In subsequent ordering No. **173** or **174** the factory number of the Stand should be stated.*

If one be already possessed of a divided circle, as, for instance, that supplied with our Goniometer Ocular, it can be adapted to take the Analyser. In this case a charge of 3 Marks, over and above that specified for the combination without divided circle, is made, for supplementing and adapting the mount of the Analyser to the existing divided circle. The divided circle must be forwarded us for this purpose.

No.		*Marks*	*Codeword*
162	**Analyser I**	**15.—**	**Pelmazo**
163	„ **II,** with divided circle	**30.—**	**Pelon**
165	**Analyser-Ocular I** for Achromats	**40.—**	**Pelotear**
166	„ „ **II** „ „ with divided circle .	**55.—**	**Peloton**
167	„ „ **III** „ Apochromats	**53.—**	**Peltre**
168	„ „ **IV** „ „ with divided circle	**68.—**	**Peluca**
	Combinations of Polariser and Analyser.		
	A. for **Stands I, III** and **IV:**		
169	**Polariser I** and **Analyser II**	**58.—**	**Pelusilla**
170	„ **I** „ „ **I**	**41.—**	**Pena**
171	„ **I** „ **ABBE's Analyser-Ocular II**	**83.—**	**Penador**
172	„ **I** „ „ „ „ **I**	**66.—**	**Pename**
	B. for **Stand V:**		
173	**Polariser II** and **Analyser II**	**61.—**	**Pencazo**
174	„ **II** „ „ **I**	**44.—**	**Pendado**

No. **177. Axial-image Ocular.** With the large **Mineralogical Stand III M** a **BERTRAND lens** forms the objective of an auxiliary microscope for observing axial images. For the same purposes we provide a special auxiliary, the **Axial-image Ocular,** to be used in conjunction with our other stands.

No. **178. *Iris-diaphragm with Ocular.** For examining and accurately identifying the axial images of small crystals we supply **Iris-diaphragm with Ocular** which fits into the tube.

See special prospectus relating to appliances for investigation with polarised light.

Nos. **179** to **182. Selenite and Mica Films.** We supply regularly four **selenite films** Red of the I., II., III. and IV. Order; also four different **mica films** $^1/_8\ \lambda$, $^1/_4\ \lambda$, $^3/_8\ \lambda$ and $^1/_2\ \lambda$. These 8 films compose the **set of selenite and mica films** originally proposed by **H. v. MOHL,** No. **179.**

We supply these films in cardboard mounts for laying on Polariser I No. **160** or in a metal mount for laying in the slide of Stand III M or for insertion between Analyser and Ocular.

A Selenite Film for Red of the I. Order generally meets all requirements.

	Marks	*Codeword*
Axial-image Ocular	**30.—**	**Pendola**
Iris-diaphragm with Ocular, to fit the tube	**25.—**	**Pendra**
MOHL's Set of Films, mounted in cardboard	**15.—**	**Peneque**
Selenite Films, Red of the I. Order, for Polariser I .	**3.—**	**Penetrar**
„ „ „ „ „ I. „ for the slide of Stand III M . .	**4.—**	**Penible**
„ „ „ „ „ I. „ for insertion between Ocular and Analyser	**4.—**	**Peninsula**

Selenite Films of other orders, in cardboard mounts, each **2** Mks., in metal mounts, each **3** Mks.; **Mica Films,** in cardboard mounts, each **1.50** Mks., in metal mounts, each **2.50** Mks.

Regarding other crystal films for similar purposes we must refer to the special prospectus relating to appliances for investigations with polarised light.

E. Miscellaneous Accessory Apparatus.

Oculars for special purposes.

No. 189. ***ABBE's Stereoscopic Ocular.** Fig. 41. This apparatus is designed for stereoscopic as well as ordinary binocular observation of microscopical objects with any desired magnification. (See CARL's "Repertorium", vol. XVII, 1881, pp. 197—224; also Journ. of the R. Micr. Soc. (2), vol. I, 1881, pp. 203—211; E. ABBE, Ges. Abhdl., vol. I, 1904, pp. 244—272.)

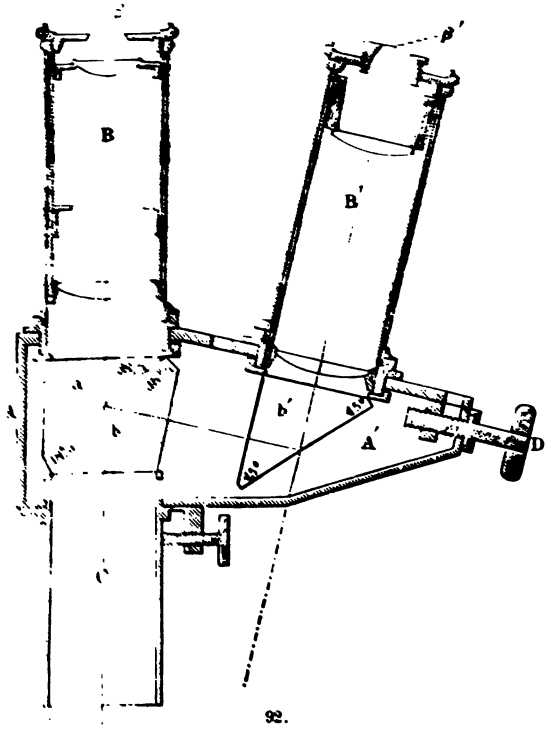


Fig. 40. ABBE's Stereoscopic Ocular, No. 189. (⅔ Full Size.)

The division of the pencil of rays emerging from the objective, with the object of producing two separate images, is effected at the upper end of the tube by partial reflection at a thin stratum of air between the two prisms *a* and *b*.

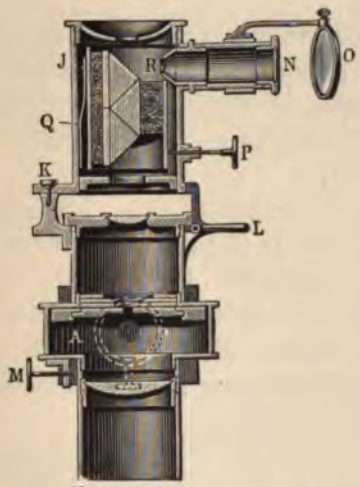
		Marks	*Codeword*
189.	**ABBE's Stereoscopic Ocular**, in case	180.—	**Peonia**

The bisection of the pencils for producing stereoscopic effect is made by adjustable semi-circular stops placed over the oculars, without these, i. e., with fully exposed oculars, the instrument gives binocular vision without specific stereoscopic effect.

The distance between the oculars is adjustable — by altering the position of one of the ocular tubes — to suit the inter-pupillary distance of any individual observer's eyes. The instrument is available (but in conjunction with achromatic objectives only) for use on any of our large stands in which the tubes admit of shortening to at least 140 mm ($5^1/_2$ in.).

No. **190. *ABBE's Spectroscopic Ocular (Micro-Spectroscope).** Fig. 42. This ocular is specially designed for the examination of the absorption spectra of microscopic objects, but is also adapted for spectroscopic analysis of larger objects, liquid strata, etc.

The achromatic eye-lens is accurately adjustable with respect to the slit situated in the plane of the diaphragm. By a lever arrangement a comparison prism can be applied to the slit to facilitate spectroscopic comparison of the object with other absorption media, which are attached in suitable holders at the side of the ocular. An assortment of small glass tubes is supplied for this purpose.



93.

Longitudinal section of the whole instrument.
($^1/_2$ Full Size.)

94.

Slit mechanism separately.
(Plan view; Full Size.)

Fig. 42. ABBE's Micro-Spectroscope, No. 190.

A direct-vision AMICI prism, which may be turned aside about a pivot, is placed above the ocular. A scale of wave-lengths is projected upon the

		Marks	*Codeword*
)	**ABBE's Spectroscopic Ocular (Micro-spectroscope),** in case	**200.—**	**Peorus**

spectrum by means of a tube, with mirror and lens, attached at the side of the prism casing.

For fuller particulars regarding its construction see the directions accompanying the instrument.

Nos. **191** and **191a**. ***ENGELMANN's Micro-spectro-photometer.** This apparatus — designed for quantitative micro-spectrum analysis — is constructed on the principle of VIERORDT's spectro-photometers. The Apparatus No. **191** is provided with prisms, No. **191a** with grating for the production of the spectrum.

As to the use of the apparatus we would refer to the instructions given in Zeitschr. f. wiss. Mikrosk., vol. V, 1888, pp. 289—296 and Sitzungsber. d. Berl. Akad., vol. XXXII, 1902, pp. 706—710.

No. **192**. ***Drum fitted with PORRO's Prisms for erecting the images.** Similarly as in our image erecting microscopes the PORRO prisms of this ocular are encased in a drum, below which is a sleeve fitting the tube of the microscope. A second sleeve on the upper end of the drum takes any ocular desired.

No. **193**. **AMICI Erecting Prism ("prisme redresseur").** This prism, which is supplied in a mount fitting the ocular, besides erecting the image affords the additional advantage of a comfortable position of the head, the optical axis (the direction of vision) being inclined about 30° to the axis of the tube.

Nos. **194** and **195**. ***Index-Oculars.** In the course of class demonstrations it is often found desirable to be able to mark any particular point of the object by means of an index. To meet this want we supply the HUYGENIAN oculars **2** and **3**, as also compensating ocular **6** — in the form of drum oculars with micrometer (see p. 76) — fitted with a **movable index**, No. **195a**, which can be adjusted laterally by means of a screw in the same manner as a micrometer scale.

No.		*Marks*	*Codeword*
191	**ENGELMANN's Micro-spectro-photometer,** in case	**480.—**	**Pepino**
191a	**The same apparatus as No. 191,** but with **grating** . . .	**510.—**	**Pepite**
192	**Drum fitted with PORRO's Prisms** without Ocular, in case	**40.—**	**Pepitoso**
193	**AMICI's Erecting Prism,** in case	**25.—**	**Peragrar**
194	**Index Ocular** HUYGENIAN Ocular **2** or **3**	**36.—**	**Peraleda**
195	**Index Ocular** Compensating Ocular **6**	**49.—**	**Peranton**
195a	**Index,** alone	**1.—**	**Percance**

Cross-line Oculars. The process of centring the object-stage or the objective by means of special centring appliances as well as in investigations in polarised light requires that the centre of the field should be indicated by a mark in the plane of the diaphragm of the ocular. For this purpose we supply **glass discs ruled with cross-lines** for dropping into the ocular.

The addition of such a disc raises the price of an ocular by Marks **4.**—. If it be also desired to have the eye-lens adjustable, a further charge of Marks **7.**— is to be added.

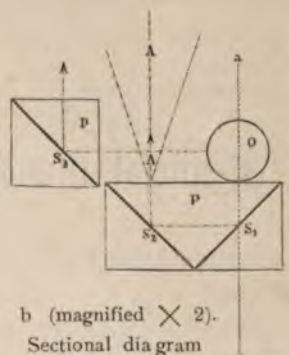
In subsequent ordering of the glass disc ruled with cross-lines it should be stated whether the discs are intended for ordinary oculars or oculars with adjustable eye-lens.

*Greenough's Prism and Capillary Rotators.

These two instruments are more especially designed to facilitate the examination, from different sides in succession, of objects so small that the control of their movements under the microscope would be difficult to accomplish by hand.

Nos. **196** and **107**. **Prism Rotator.** Fig. 43. The upper surface of the object is seen direct, the lower side is viewed after double reflection (see Fig. 43b) at s_1 and s_2, while rotation round the axis *aa* and reflection at s_3 facilitate examination of all remaining portions of the object.

a ($^2/_3$ Full Size).



b (magnified × 2). Sectional diagram of prisms.

Fig. 43. Prism Rotator, No. 196.

No.		*Marks*	*Codeword*
196	**Greenough's Prism Rotator,** in case	**62.**—	**Perceptor**
197	**The same apparatus** as No. **196, but with double reflection for side views,** in case	**75.**—	**Percudir**

The positions "right" and "left" being reversed in consequence of the single reflection at s_3, and as this would cause inconvenience in certain cases we construct a second form of the instrument, No. **197**, in which the objectionable reversal is obviated by the addition of another prism.

No. **198.** The **Capillary Rotator,** Fig. 44, serves to rotate about a horizontal axis small objects which may be contained in a capillary tube. The instrument is so arranged that the capillary tubes may be rotated within a chamber fitted with cedar-wood oil, so as to obviate the disturbing effects of irregular refraction and of reflection caused by the walls of the tubes.

Fig. 44. Capillary Rotator, No. 198. ($^3/_5$ Full Size.)

While the Prism Rotator is primarily designed for use on Binocular Stand **X**^{a}, but may also be used with other stands having a stage opening 33 mm ($1^1/_8$ in.) in diameter, the Capillary Rotator, because it may be held by means of clips like any ordinary object-carrier, is adapted for all stands alike.

Regarding the details of the construction of the two instruments see Zeitschrift f. wiss. Mikrosk., vol. XIV, 1897, pp. 304—312.

Artificial Illuminating Appliances for the Microscope.

Lamplight, if properly regulated, may almost completely replace good daylight.

It is advisable to interpose between the source of light and the mirror of the microscope a spherical glass flask filled with water (such as is sometimes used by engravers) or, better still, a simple collective lens, so as to project a sufficiently large image of the source of light upon the iris-opening or upon the mirror.

No.		*Marks*	*Codeword*
198	**GREENOUGH's Capillary Rotator**	**50.—**	**Perderas**

No. **199. Incandescent Gas Lamp and Glass Flask.** For the purpose of illumination we supply an **incandescent glass lamp mounted on a brass stand** with ordinary burner and Jena glass chimney together with two reserve mantles and in combination with this lamp a **glass flask on** a special **stand.**

No. **200. Glass Flask on Stand.** This flask is also supplied separately. It has a diameter of about 15 cm (6 in.). It is most efficient when placed midway between lamp and microscope at a distance of 15 cm from both.

No. **201. Collective Lens with Iris-diaphragm.** This apparatus consists of a simple **collective lens** (of about 125 mm [$4^7/_8$ in.] length) with an **iris-diaphragm** attached to its mount. It stands upon a massive foot and the lens is adjustable in height. This appliance helps, not only to produce a better image of the source of light, but also to confine the illuminated portion of the field within sharply defined limits. It is for this reason that it is so well adapted for illumination by means of the vertical illuminator (see pp. 34 and 35).

Spectroscopes.

Nos. **202** to **204. Browning's Hand-Spectroscopes.**

This form of spectroscope is fitted with a set of Amici prisms of great dispersion and is principally intended for the examination of large objects as, for instance, troughs filled with liquid matter.

For particulars of other spectroscopes consult the special prospectuses issued by our Department of Optical Measuring Instruments.

No.		*Marks*	*Codeword*
199	**Incandescent Gas Lamp with Glass Flask on Stand** . .	**22.—**	**Perdidoso**
200	**Glass Flask** separately	**7.—**	**Perdigon**
201	**Collective Lens with Iris-diaphragm,** on stand with massive round foot	**36.—**	**Perdon**
202	**Hand-Spectroscope,** without comparison prism, in case	**40.—**	**Perdurar**
203	„ „ with „ „ „ „	**46.—**	**Peregrina**
204	„ „ with scale of wave lengths „ „	**80.—**	**Perenal**

Heating Apparatus.

Nos. **209** to **211.** **L. PFEIFFER's Heating Chamber** for heating microscopical objects during observation. (See L. PFEIFFER, "Protozoen als Krankheitserreger etc", 2nd edition, Jena, 1891.)

The chamber consists of a mahogany box encasing the whole of the microscope, with a window in the front to admit the necessary light. On either side is a closely fitting door through which the specimen can be moved with the fingers. The side walls may also be completely folded back, carrying with them the halves of the back wall, which is divided down the middle.

The whole (chamber and microscope stand) rests upon a thick metal plate on three legs. The metal plate is heated from below by a **micro-burner,** No. **212,** controlled by a **thermo-regulator,** No. **215,** and should be adjusted so as to burn with smokeless flame.

By this means the whole stand and the air surrounding it are gradually brought to the same temperature, so that after a reasonable lapse of time the readings of the thermometer placed in the air space indicate the actual temperature of the object on the stage.

The temperature may be raised to 45° C (113° F) without risk of injury to the Stand or optical equipment.

We supply this heating chamber in various forms, suitable for Stands with the older form of fine adjustment and for those with BERGER's micrometer movement.

In subsequent orders the factory number of the Stand, intended to be used with the heating chamber, should be given. A thermo-regulator, No. 215, as well as a thermometer, accompanies each heating chamber, but the micro-burner, No. 212, must be ordered specially.

Nos. **213** and **214.** **L. PFEIFFER's Heating Stage.** We are prepared to supply this apparatus as constructed by E. LEYBOLD's successor, of Cologne.

No.		*Marks*	*Codeword*
209	**PFEIFFER's Heating Chamber** for Stand **IV**	**70.—**	**Pergenaba**
210	„ „ „ „ „ **I** and **III**	**100.—**	**Periclytus**
211	„ „ „ „ „ **V**	**65.—**	**Periforme**
212	**Micro-burner** for the Heating Chamber	**4.50**	**Perilustre**
213	**Heating Stage** with flat surface	**9.—**	**Perineo**
214	„ „ „ 3 concavities	**15.—**	**Periodo**
215	**Thermo-regulator** for above heating appliances	**10.—**	**Periplo**

This stage consists of a glass box made by the LEYBOLD sealing process, which may be directly used as an object-carrier. A thermometer and inlet and outlet tubes for heated water are fitted at the side of the glass box. In order that this stage may also be available for hanging-drop observations, we supply the same, if so ordered, with three concavities, ground out of the upper glass surface, upon which the cover-glasses are placed.

No. **216. ZOTH's Cooling Trough,** which is more especially designed for purposes of micro-projection, may also be fitted with a **thermometer** and will in this form be found to serve as a useful **heating stage.**

Other Accessory Appliances.

No. **217. MALTWOOD's Finder.** This simple contrivance for re-finding certain points of an object consists principally of a net-work of separately numbered small squares photographed upon glass. (See Zeitschr. f. wiss. Mikrosk. vol. V, 1888, p. 40.)

No. **218. BORN and PETER's Orientation Plate,** constructed by us at the suggestion of the gentlemen after whom it is named, serves to mark the position of objects contained in hardening paraffin and at the same time to impress the **lines of direction** upon the paraffin blocks. For the latter purpose one side of the plate has several parallel grooves, of equal width and with sharp edges, cut into it. (See Zeitschr. f. wiss. Mikrosk., vol. XV, 1898, pp. 31—49.)

We generally supply a pair of glass set-squares, No. **219**, together with the instrument.

No. **220. Turn-Table (Tournette),** on wood base, for ringing specimens.

No.		*Marks*	*Codeword*
216	**ZOTH's Cooling Trough, with thermometer**	**17.50**	**Peritoneo**
217	**MALTWOOD's Finder,** in case	**20.—**	**Perlado**
218	**BORN and PETER's Orientation Plate,** with glass set-squares	**40.—**	**Perlongar**
219	**Pair of glass set-squares** separately	**10.—**	**Permeable**
220	**Turntable (Tournette)** on wooden base.	**11.—**	**Permitir**

Bell-Glasses, Slides, Cover-Glasses.

No.		*Marks*	*Codeword*
	Bell-glasses for covering up microscopes (dust-proof), incl. a stout cloth-covered mill-board base:		
221	Large size, about 38 cm (15 in.) high, 24 cm (9½ in.) inside diameter	10.—	Perneador
222	Smaller size, about 35 cm (14 in.) high, 20 cm (8 in.) inside diameter	8.—	Perneria
	Plane Ground-glass Discs for use as bed-plates:		
223	for the large bell-glasses	7.—	Pernigon
224	for the smaller bell-glasses	5.50	Pernoctar
225	**Slides of the Giessen size,** 48 × 28 mm (1⅞ × 1⅛ in):		
	a) white crown-glass, unground edges, per 100	1.50	Perolillo
	b) white crown-glass, ground edges, per 100	2.50	Perpasar
	c) white plate-glass, ground edges, per 100	5.—	Perpetrar
226	**Slides of the English size,** 76 mm × 26 mm (3 × 1 in.):		
	a) white crown-glass, unground edges, per 100	2.—	Perplejo
	b) white crown-glass, ground edges, per 100	3.—	Perquerir
	c) white plate-glass, ground edges, per 100	7.—	Perrezno
227	**Slides of extra large size,** 87 mm × 37 mm (3⅜ × 1½ in.):		
	a) white crown-glass, unground edges, per 100	3.50	Persequir
	b) white crown-glass, ground edges, per 100	5.—	Persignar
228	**Slides with polished concavities:**		
	a) small size, 55 mm × 32 mm (2¼ × 1¼ in.), best make and finish, edges bevelled, each	0.50	Personaza
	b) extra large size, 87 mm × 37 mm (3⅜ × 1½ in.), best make, edges bevelled and polished, each	1.—	Personilla
229	**Slides with cemented glass rings,** for moist chambers, 1 or 2 mm deep, each	0.80	Persuadir
230	**Cover-glasses, Squares:**		
	a) size: 24 mm □, per 100	4.50	Persuasor
	b) „ 21 „ „ „ 100	3.—	Pertinace
	c) „ 18 „ „ „ 100	2.—	Perturbar
	d) „ 15 „ „ „ 100	1.50	Perulera
	e) „ 12 „ „ „ 100	1.—	Perverso

		Marks	*Codeword*
	Cover-glasses, Circles:		
	a) size: 24 mm diameter, per 100	5.—	**Pesadilla**
	b) „ 21 „ „ „ 100	4.—	**Pesalicor**
	c) „ 18 „ „ „ 100	2.50	**Pesaroso**
	d) „ 15 „ „ „ 100	2.—	**Pescadora**
	e) „ 12 „ „ „ 100	1.50	**Pescozon**
	Cover-glasses, Oblongs:		
	a) size: 32 mm × 24 mm, per 100	6.—	**Pesebre**
	b) „ 24 „ × 21 „ „ 100	3.50	**Pespuntar**

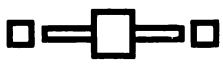
The thickness of the above cover-glasses varies between 0.15 mm and 0.22 mm; one third must be added to the prices quoted if covers of special given thickness are required.

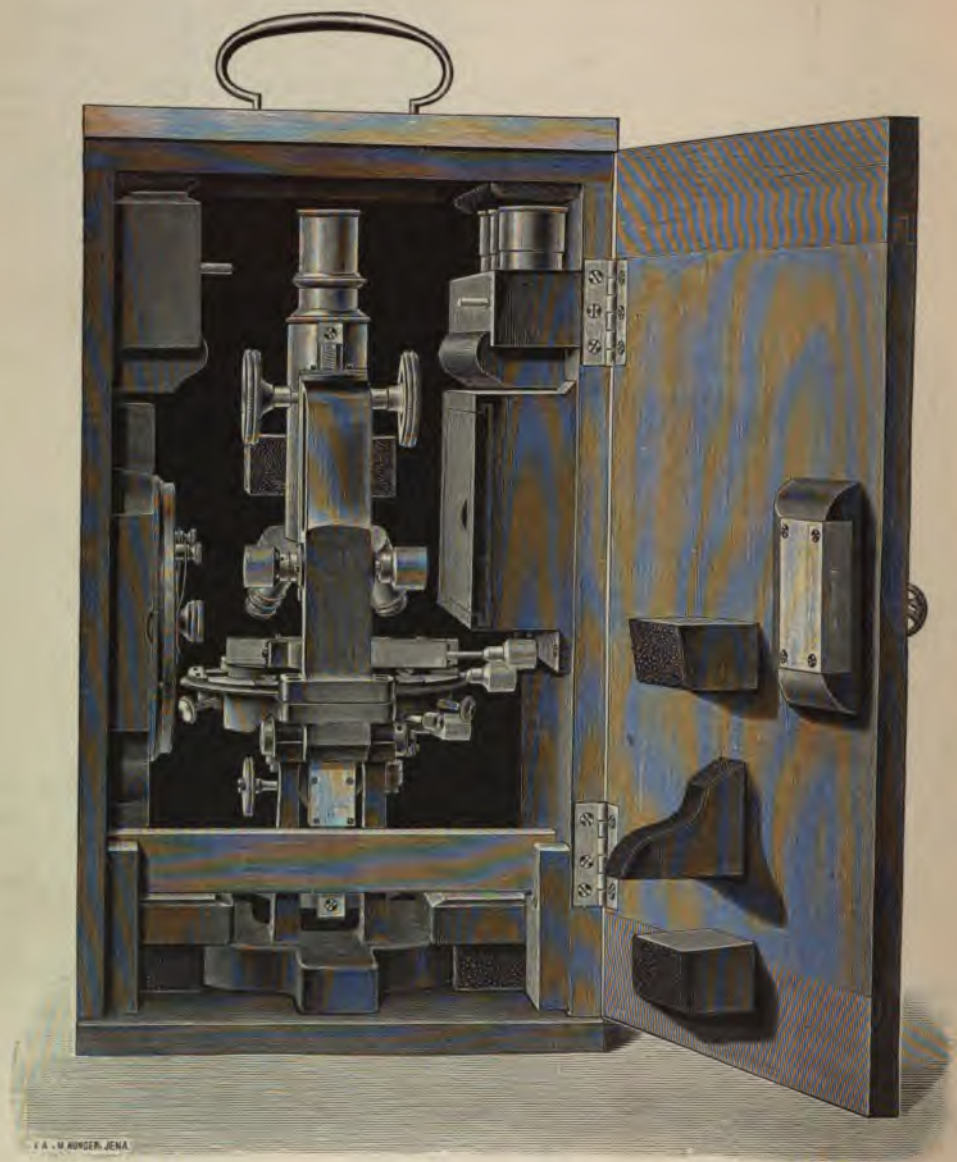
With regard to systems for dissecting, magnifiers, dissecting stands and stands for magnifiers please consult our special prospectus relating to these pieces of apparatus.

In order to meet the requirements of our customers abroad we shall at all times be pleased to obtain from the best sources, and supply at maker's prices,

Microtomes,
Cases of Dissecting Instruments,
Microscopic Preparations

which may be required to supplement any microscopic outfit purchased from us.





167.

Fig. 45.

Stand III housed in its cabinet.

($^1/_3$ Full Size.)

Complete Microscopes.

As a convenient guide to the selection of stands and their optical equipment, together with the requisite accessory apparatus, we append a number of combinations suitable for a great variety of purposes. It is not, however, our intention to place the least restriction on the free choice of our customers.

In ordering a set corresponding to one of the specifications it will be sufficient to quote either the respective number and the total cost or the codeword.

A. Complete Microscope Outfits, comprising all the more important Accessory Apparatus.

Specification 1.

Apochromatic Objectives:

16 mm / 0.30 num. Ap.	8 mm / 0.65 num. Ap.	4 mm / 0.95 num. Ap.		
80.—	100.—	140.—	.	Mk. 320.—
2.5 mm / 1.25 num. Ap.	(Water Immersion)		„	250.—
2 mm / 1.30 num. Ap.	3 mm / 1.40 num. Ap.	(Homog. Immers.)		
300.—	400.—	. . . . .	„	700.—

Compensating Oculars:

2	4	8	12	18		
20.—	20.—	30.—	30.—	25.—	. . . . .	„ 125.—
6 (Micrometer Ocular, No. 122)						„ 31.—

Achromatic Objectives:

a_0	a_2	a*	aa	B		
12.—	12.—	40.—	27.—	30.—	. . . . .	„ 121.—
Pl	D*	(Water Immersions)				
20.—	75.—	. . . . .				„ 95.—

HUYGENIAN **Oculars:**

1, 4, 5	„	18.—
2 with cross lines and adjustable eye-lens . . .	„	17.—
3 (Micrometer Ocular, No. 120)	„	18.— Mk. 1695.—
Glass Cell for the Plankton-searcher No. 2030 .	„	3.50
Centring Achromatic Condenser No. 29 . .	„	75.—
ENGELMANN'S **Micro-spectral Objective** No. 34	„	160.—
Revolving Vulcanite Stage No. 45	„	25.— „ 263.50
	Carried Forward	Mk. 1958.50

	Brought Forward		Mk. 1958.50	*Codeword*
Revolving Nose-piece for 4 Objectives, No. 50	Mk.	25.—		
Tube-slide No. 52	„	8.—		
6 Objective slides No. 53	„	48.—		
Case to hold 6 Objective-slides, No. 55	„	15.—		
Drawing Apparatus No. 111	„	60.—		
Drawing-table No. 114	„	52.—		
Stage Micrometer No. 118	„	10.—		
Screw Micrometer Ocular No. 125	„	105.—		
Stage Screw Micrometer No. 126	„	120.—		
Cover-glass Gauge No. 129	„	30.—		
Rules on plate-glass No. 132 and 134	„	11.—		
Fully divided Circle No. 139	„	20.—		
Haemocytometer No. 149	„	30.—		
Apertometer No. 156	„	90.—		
Test-plate No. 157	„	10.—		
Diffraction Apparatus No. 158	„	20.—		
Polarising Apparatus No. 169	„	58.—		
Assortment of **Selenite** and **Mica Films,** No. 179	„	15.—		
Spectroscopic Ocular No. 190	„	200.—		
Drum fitted with PORRO-prisms, No. 192	„	40.—		
Index Ocular No. 195	„	49.—		
Prism Rotator No. 197	„	75.—		
Capillary Rotator No. 198	„	50.—		
Gas Lamp and spherical glass flask, No. 199	„	22.—		
Collective Lens with iris-diaphragm, No. 201	„	36.—		
Heating Stage No. 214	„	15.—		
Thermo-regulator No. 215	„	10.—		
MALTWOOD's **Finder** No. 217	„	20.—		
BORN-PETER's **Orientation Plate** No. 218	„	40.—		
Turn-table No. 220	„	11.—	„	1295.—
Outfit completed by adding:				
a) **Stand I** B No. 5710	„	425.—		
Leather travelling case	„	36.—		
Packing	„	9.—	„ 470.—	Mk. **3723.50** **Pestiferer**
or				
b) **Stand I** E No. 6010	„	440.—		
Leather travelling case	„	36.—		
Packing	„	9.—	„ 485.—	Mk. **3738.50** **Pestonando**

Regarding apparatus for dissecting purposes required as a suitable complement to Specification I see the foot note on p. 99.

Specification 2.

Achromatic Objectives:

a_2	a*	aa	AA	B	C	DD	
12.—	40.—	27.—	30.—	30.—	30.—	50.—	Mk. 219.—

E with corr. collar. **F** with corr. collar.

80.— 95.— „ 175.—

Carried Forward Mk. 394.—

		Brought Forward		Mk. 394.—		*Codeword*
Pl D* **J** with corr. collar (Water Immers.)						
20.— 75.— 130.—	Mk.	225.—				
$\frac{1''}{12}$ (Homogeneous Immersion)	„	125.—				
HUYGENIAN **Oculars:**						
1, 2, 4, 5	„	24.—				
3 (Micrometer Ocular No. 120)	„	18.—	„	786.—		
Glass Cell for the Plankton-searcher No. 2030	„	3.50				
Revolving Vulcanite Stage No. 45	„	25.—				
Revolving Nose-piece for 4 Objectives, No. 50	„	25.—				
Drawing Apparatus No. 111	„	60.—				
Drawing-table No. 114	„	52.—				
Stage Micrometer No. 118	„	10.—				
Screw Micrometer Ocular No. 124	„	90.—				
Cover-glass Gauge No. 130	„	15.—				
Haemocytometer No. 149	„	30.—				
Apertometer No. 155	„	70.—				
Test-plate No. 157	„	10.—				
Polarising Apparatus No. 169	„	58.—				
Selenite Film for Red of the I. Order, No. 180	„	3.—				
Spectroscopic Ocular No. 190	„	200.—				
Drum fitted with PORRO-prisms, No. 192	„	40.—				
Index Ocular No. 194	„	36.—				
Prism Rotator No. 196	„	62.—				
Capillary Rotator No. 198	„	50.—				
Gas Lamp and spherical glass flask, No. 199	„	22.—				
MALTWOOD'S **Finder** No. 217	„	20.—				
Outfit completed by adding:			„	881.50		
a) **Stand I** B No. 5705	„	400.—				
Leather case	„	36.—				
Packing	„	8.—	„	444.—	Mk. **2111.50**	**Petardant**
or						
b) **Stand I** E No. 6005	„	415.—				
Leather case	„	36.—				
Packing	„	8.—	„	459.—	„ **2126.50**	**Petechial**
or						
c) **Stand III** E No. 6505	„	365.—				
Packing	„	8.—	„	373.—	„ **2040.50**	**Petiginis**
or						
d) **Stand IV** E No. 7205	„	335.—				
Packing	„	8.—	„	343.—	„ **2010.50**	**Petilleres**

As a suitable complement to specifications 1 and 2 for dissecting purposes we would recommend the addition of one of the Specifications Nos. 17, 18, 20 or 21. If No. 17a be chosen, the Prism Rotator and the Capillary Rotator, and in the Nos. 20 and 21 the Objective a* as well as the HUYGENIAN Oculars 2 and 4, would be omitted.

B. Complete Microscopes, equipped with only the most indispensable Accessory Apparatus, but generally sufficient for histological, bacteriological, botanical and zoological research.

Specification 3.

Apochromatic Objectives:

16 mm	8 mm	4 mm			*Codeword*
0.30 num. Ap.	0.65 num. Ap.	0.95 num. Ap.			
80.—	100.—	140.— . . .	Mk.	320.—	
2 mm	(Homogeneous Immersion) . . .		„	300.—	
1.30 num. Ap.					

Compensating Oculars:

2	4	8	12					
20.—	20.—	30.—	30.—		„	100.—		
6 (Micrometer Ocular No. 122)					„	31.—	Mk.	751.—
Tube-slide No. 52					„	8.—		
4 Objective-slides No. 53					„	32.—		
Case to hold 6 Objective-slides, No. 55					„	15.—		
Drawing Apparatus No. 111					„	60.—		
Stage Micrometer No. 118					„	10.—		
Haemocytometer No. 149					„	30.—	„	155.—

Outfit completed by adding:

a) **Stand** IB No 5705	„	400.—				
Polarising Apparatus No. 169, and						
Selenite Film No. 180	„	61.—				
Packing	„	4.—	„	465.—	Mk.	**1371.— Petitorias**
or						
b) **Stand** IIIE No. 6505	„	365.—				
Polarising Apparatus No. 169, and						
Selenite Film No. 180	„	61.—				
Packing	„	4.—	„	430.—	„	**1336.— Petrifiant**
or						
c) **Stand** IIID No. 6405	„	290.—				
Polarising Apparatus No. 169, and						
Selenite Film No. 180	„	61.—				
Packing	„	4.—	„	355.—	„	**1261.— Petrolerie**
or						
d) **Stand** IVD No. 7105	„	260.—				
Packing	„	4.—	„	264.—	„	**1170.— Peucedanin**

Specification 4.

Achromatic Objectives:

a_2	a*	AA	C	DD	F					*Codeword*
12.—	40.—	30.—	30.—	50.—	75.—	. . .	Mk.	237.—		
Pl	**D***	**J**	(Water Immersions)							
20.—	75.—	110.—	. . . . .				„	205.—		
$\frac{1}{12}$ "	(Homogeneous Immersion)	. . . . .					„	125.—		

HUYGENIAN **Oculars:**

1, 2, 4, 5		„	24.—	
3 (Micrometer Ocular No. 120)		„	18.—	Mk. 609.—
Glass Cell for the Plankton-searcher No. 2030 .		„	3.50	
Revolving Nose-piece for 4 Objectives, No. 50		„	25.—	
Drawing Apparatus No. 111		„	60.—	
Stage Micrometer No. 118		„	10.—	
Counting Chamber No. 142		„	15.—	„ 113.50

Outfit completed by adding:

a) **Stand** I A No. 5605	„	325.—				
Polarising Apparatus No. 170, and						
Selenite Film No. 180	„	44.—				
Packing	„	3.—	„ 372.—	Mk.	**1094.50**	**Piariegas**
or						
b) **Stand** III D No. 6405	„	290.—				
Polarising Apparatus No. 170, and						
Selenite Film No. 180	„	44.—				
Packing	„	3.—	„ 337.—	„	**1059.50**	**Picadinha**
or						
c) **Stand** IV D No. 7105	„	260.—				
Polarising Apparatus No. 170, and						
Selenite Film No. 180	„	44.—				
Packing	„	3.—	„ 307.—	„	**1029.50**	**Picamare**
or						
d) **Stand** III C No. 6305	„	250.—				
Packing	„	3.—	„ 253.—	„	**975.50**	**Picaraza**
or						
e) **Stand** IV C No. 7005	„	225.—				
Packing	„	3.—	„ 228.—	„	**950.50**	**Picaresque**
or						
f) **Stand** IV B No. 6905	„	210.—				
Packing	„	3.—	„ 213.—	„	**935.50**	**Picaturam**

C. Microscopes suitable for specific purposes.

Specification 5.

Microscopes for bacteriological research.

(A suitable outfit for clinical laboratories, hospitals, hygienic institutions, medical practitioners and veterinary surgeons.)

Achromatic Objectives:

AA	DD				
30.—	50.—	Mk.	80.—		*Codeword*

Apochromatic homogeneous immersion Objective:

2 mm / 1.30 num. Ap.	„	300.—		

HUYGENIAN **Oculars:**

2, 4	„	12.—		

Compensating Oculars:

4	8					
20.—	30.—	„	50.—			
6 (Micrometer Ocular No. 122)		„	31.—			
Revolving Nose-piece for 3 Objectives, No. 49		„	20.—	Mk.	493.—	
Outfit completed by adding:						
a) **Stand I** A No. 5610		„	350.—			
Leather travelling case		„	36.—			
	Packing	„	3.—	„	389.— Mk. 882.—	**Pichorra**
or						
b) **Stand III** D No. 6410		„	315.—			
	Packing	„	3.—	„	318.— „ 811.—	**Picicorne**
or						
c) **Stand IV** D No. 7105		„	260.—			
	Packing	„	3.—	„	263.— „ 756.—	**Piconero**

Specification 6.

Microscopes for similar purposes, but less expensive.

Achromatic Objectives:

A	DD				
20.—	50.—	Mk.	70.—		
$\frac{1}{12}$ " (Homogeneous Immersion)		„	125.—		

HUYGENIAN **Oculars:**

2, 4	„	12.—		
3 (Micrometer Ocular No. 120)	„	18.—		
Revolving Nose-piece for 3 Objectives, No. 49	„	20.—	Mk.	245.—
	Carried Forward		Mk.	245.—

					Codeword
	Brought Forward		Mk. 245.—		
Outfit completed by adding:					
a) **Stand III** D No. 6405	Mk. 290.—				
Packing	„ 2.50	„ 292.50	Mk. **537.50**		**Picoteares**
or					
b) **Stand IV** D No. 7105	„ 260.—				
Packing	„ 2.50	„ 262.50	„ **507.50**		**Picramyle**
or					
c) **Stand IV** C No. 7005	„ 225.—				
Packing	„ 2.50	„ 227.50	„ **472.50**		**Picrosmine**
or					
d) **Stand VI**[a] No. 82	„ 150.—				
Packing	„ 2.—	„ 152.—	„ **397.—**		**Pictores**
or					
e) **Stand VI**[a] No. 83 (Travelling Microscope)	„ 165.—				
Packing	„ 1.50	„ 166.50	„ **411.50**		**Picudos**
or					
f) **Stand V** B No. 7505	„ 120.—				
Packing	„ 1.50	„ 121.50	„ **366.50**		**Piecard**

The optical details enumerated in Specifications 5 and 6 were adopted for the Microscopes used in the Prussian Military Hospitals. Professor R. KOCH declares them to be indispensable in bacteriological research.

The total cost of Specification 6 may be still further reduced by omitting the micrometer Ocular No. 120 and by substituting Objective **D** for **DD**, which would result in a saving of Mk. 33.—.

Specification 7.

Microscopes for histological, botanical and zoological investigations.

Achromatic Objectives:

a_2	a*	A	C	E			
12.—	40.—	20.—	30.—	60.—	Mk.	162.—	
Pl (Water Immersion)					„	20.—	
$\frac{1''}{12}$ (Homogeneous Immersion)					„	125.—	
HUYGENIAN **Oculars:**							
2, 4					„	12.—	
3 (Micrometer Ocular No. 120)					„	18.—	Mk. 337.—
Glass Cell for the Plankton-searcher, No. 2030 .					„	3.50	
Revolving Nose-piece for 3 Objectives, No. 49					„	20.—	
Drawing Apparatus No. 111					„	60.—	
Stage Micrometer No. 118					„	10.—	„ 93.50
					Carried Forward		Mk. 430.50

Outfit completed by adding:					Codeword
	Brought Forward	Mk. 430.50			
a) **Stand III** D No. 6410	Mk. 315.—				
Packing	„ 3.—	„ 318.—	Mk.	748.50	**Pienotto**
or					
b) **Stand IV** D No. 7105	„ 260.—				
Packing	„ 3.—	„ 263.—	„	693.50	**Piepente**
or					
c) **Stand IV** C No. 7005	„ 225.—				
Packing	„ 3.—	„ 228.—	„	658.50	**Pietriseo**
or					
d) **Stand VI**[a] No. 82	„ 150.—				
Packing	„ 2.—	„ 152.—	„	582.50	**Pievanato**
or					
e) **Stand V** B No. 7505	„ 120.—				
Packing	„ 1.50	„ 121.50	„	552.—	**Piezonote**

Specification 8.

Microscopes for similar purposes, but less expensive.

Achromatic Objectives:

a_2	A	C	E		
12.—	20.—	30.—	60.—	Mk. 122.—	
$\frac{1}{12}''$ (Homogeneous Immersion)				„ 125.—	

HUYGENIAN **Oculars:**

2, 4	„ 12.—	
3 (Micrometer Ocular No. 120)	„ 18.—	Mk. 277.—
Revolving Nose-piece for 3 Objectives, No. 49	„ 20.—	
Drawing-prism No. 109	„ 21.—	
Drawing-board No. 115	„ 2.50	
Stage Micrometer No. 118	„ 10.—	„ 53.50

Outfit completed by adding:

a) **Stand III** D No. 6405	„ 290.—			
Packing	„ 3.—	„ 293.—	Mk.	623.50 **Pigneratio**
or				
b) **Stand IV** D No. 7105	„ 260.—			
Packing	„ 3.—	„ 263.—	„	593.50 **Pignorada**
or				
c) **Stand IV** C No. 7005	„ 225.—			
Packing	„ 3.—	„ 228.—	„	558.50 **Pigrantes**
or				
d) **Stand VI**[a] No. 82	„ 150.—			
Packing	„ 2.50	„ 152.50	„	483.— **Pigritaris**
or				
e) **Stand V** B No. 7505	„ 120.—			
Packing	„ 2.—	„ 122.—	„	452.50 **Pilaremus**

Specification 9.

Microscopes adapted for histological, botanical and zoological courses:

also in accordance with the German regulations for the conduct of pharmacies.

Achromatic Objectives: *Codeword*

a_2	A	D						
12.—	20.—	35.—		Mk.	67.—			
HUYGENIAN **Oculars:**								
2, 4				„	12.—			
Ocular Micrometer No. 117				„	5.—	Mk. 84.—		
Outfit completed by adding:								
a) **Stand VI**[a] No. 80				„	130.—			
			Packing	„	1.50	„ 131.50	Mk. **215.50**	**Pilavistis**
or								
b) **Stand V A** No. 7405				„	100.—			
			Packing	„	1.—	„ 101.—	„ **185.—**	**Pileanthe**
or (if Polarising Apparatus be desired)								
c) **Stand V D** No. 7705, with Iris-diaphragm No. 3810				„	178.—			
			Packing	„	1.80	„ 179.80	„ **263.80**	**Pilicrepos**

Specification 10.

Microscopes adapted for histological investigation in polarised light.

Achromatic Objectives:

a_2	A	DD						
12.—	20.—	50.—		Mk.	82.—			
$\frac{1''}{12}$ (Homogeneous Immersion)				„	125.—			
HUYGENIAN **Oculars:**								
2, 4				„	12.—			
3 (Micrometer Ocular No. 120)				„	18.—	Mk. 237.—		
Outfit completed by adding:								
a) **Stand III D** No. 6410				„	315.—			
Polarising Apparatus No. 170, and **Selenite Plim** No. 180				„	44.—			
			Packing	„	2.50	„ 361.50	Mk. **598.50**	**Pillobolo**
or								
b) **Stand IV F** No. 7305				„	295.—			
			Packing	„	2.50	„ 297.50	„ **534.50**	**Pillottava**
or								
c) **Stand IV D** No. 7105				„	260.—			
Polarising Apparatus No. 170, and **Selenite Plim** No. 180				„	44.—			
			Packing	„	2.50	„ 306.50	„ **543.50**	**Pilosorum**
or								
d) **Stand V D** No. 7705, with Iris-diaphragm No. 3810				„	178.—			
			Packing	„	1.50	„ 179.50	„ **416.50**	**Pilotrico**

Specification 11.

Microscopes adapted for mineralogical and crystallographic investigations.

Achromatic Objectives:

a_2	A	DD	F					
12.—	20.—	50.—	75.—	. . . . .	Mk.	157.—		*Codeword*
$\frac{1}{12}$"	(Homogeneous Immersion)			. . . . .	„	125.—		
HUYGENIAN **Oculars** with cross-lines:								
1. 2. 4				. . . . .	„	30.—		
3 Micrometer Ocular No. 120)				. . . . .	„	18.—	Mk. 330.—	
Tube-slide No. 52				. . . . .	„	8.—		
5 Objective-slides No. 53				. . . . .	„	40.—		
Case for 6 Objective-slides No. 55				. . . . .	„	15.—		
Drawing Apparatus No. 111				. . . . .	„	60.—		
Stage Micrometer No. 118				. . . . .	„	10.—		
Adjustable **Iris-diaphragm** with Ocular No. 178					„	25.—	„ 158.—	
Outfit completed by adding:								
a) **Stand III** ME No. 6710				. . . . .	„	600.—		
Goniometer Ocular No. 127 (without divided circle)				. . . . .	„	20.—		
				Packing	„	4.—	„ 624.—	Mk. **1112.— Pipabimus**
or								
b) **Stand III** MD No. 6605				. . . . .	„	500.—		
Goniometer Ocular No. 127 (without divided circle)				. . . . .	„	20.—		
				Packing	„	4.—	„ 524.—	„ **1012.— Pipaverunt**

Specification 12.

Microscopes for mineralogical and crystallographic courses.

Achromatic Objectives:

A	D				
20.—	35.—	. . . . .	Mk.	55.—	
HUYGENIAN **Oculars** with cross-lines:					
2, 4		. . . . .	„	20.—	Mk. 75.—
Outfit completed by adding:					
a) **Stand IV** F No. 7305		. . . . .	„	295.—	
		Packing	„	2.50	„ 297.50 Mk. **372.50 Pirofobia**
or					
b) **Stand V** D No. 7705		. . . . .	„	170.—	
		Packing	„	1.50	„ 171.50 „ **246.50 Piropeaba**

Specification 13.

Microscopes specially adapted for chemical laboratories, for paper and celluloid factories, for breweries and dairies.

Achromatic Objectives:

a_2	A	D						
12.—	20.—	35.—	. . . . .	Mk.	67.—			*Codeword*
$\frac{1}{12}$"			(Homogeneous Immersion)	„	125.—			
HUYGENIAN **Oculars:**								
2, 4			. . . . .	„	12.—			
3 (Micrometer Ocular No. 120)			. . . . .	„	18.—	Mk.	222.—	
Revolving Nose-piece for 3 Objectives, No. 49				„	20.—			
Stage Micrometer No. 118			. . . . .	„	10.—			
Counting-chamber No. 142			. . . . .	„	15.—	„	45.—	
Outfit completed by adding:								
a) **Stand III** E No. 6505			. . . . .	„	365.—			
Polarising Apparatus No. 170, and **Selenite Film** No. 180			. . . . .	„	44.—			
			Packing	„	2.50	„	411.50	Mk. **678.50** **Piruetano**
or								
b) **Stand IV** F No. 7305			. . . . .	„	295.—			
			Packing	„	2.50	„	297.50	„ **564.50** **Piscabaris**
or								
c) **Stand V** D No. 7705 with Iris-diaphragm No. 3810			. . . . .	„	178.—			
			Packing	„	1.50	„	179.50	„ **446.50** **Piscicapos**

Specification 14.

Microscopes for similar purposes, but somewhat cheaper.

Achromatic Objectives:

A	C	E						
20.—	30.—	60.—	. . . . .	Mk.	110.—			
HUYGENIAN **Oculars:**								
2, 4			. . . . .	„	12.—			
3 (Micrometer Ocular No. 120)			. . . . .	„	18.—	Mk.	140.—	
Revolving Nose-piece for 3 Objectives, No. 49				„	20.—			
Counting-chamber No. 142			. . . . .	„	15.—	„	35.—	
Outfit completed by adding:								
a) **Stand IV** F No. 7305			. . . . .	„	295.—			
			Packing	„	2.50	„	297.50	Mk. **472.50** **Piscipules**
or								
b) **Stand V** D No. 7705, with Iris-diaphragm No. 3810			. . . . .	„	178.—			
			Packing	„	1.50	„	179.50	„ **354.50** **Pisonibus**
or								
c) **Stand V** B No. 7505			. . . . .	„	120.—			
			Packing	„	1.50	„	121.50	„ **296.50** **Pistabunt**

Specification 15.

Specially suitable for customs examinations of textile goods, etc.

Achromatic Objectives:

a_2	A	D						
12.—	20.—	35.—	Mk.	67.—				*Codeword*
HUYGENIAN **Oculars:**								
2, 4			„	12.—				
3 (Micrometer Ocular No. 120)			„	18.—	Mk.	97.—		
Outfit completed by adding:								
a) **Stand V** D No. 7705, with Iris-diaphragm No. 3810			„	178.—				
		Packing	„	1.—	„	179.—	Mk. **276.—**	**Pistazite**
or								
b) **Stand V** A No. 7405			„	100.—				
		Packing	„	1.—	„	101.—	„ **198.—**	**Pistoribus**

Specification 16.

For the examination of opaque objects, metal specimens, etc.

Achromatic Objectives:

a_2	A	C						
12.—	20.—	30.—	Mk.	62.—				
HUYGENIAN **Oculars:**								
2, 4			„	12.—	Mk.	74.—		
Vertical Illuminator No. 42			„	18.—				
Collective Lens with Iris-diaphragm, No. 201 .			„	36.—	„	54.—		
Outfit completed by adding:								
a) **Stand V** A No. 7405			„	100.—				
		Packing	„	1.50	„	101.50	Mk. **229.50**	**Plaudebat**
or								
b) **Stand IX** No. 91			„	50.—				
		Packing	„	1.50	„	51.50	„ **179.50**	**Plausitavi**

The apparatus designed by MARTENS and HEYN for the investigation and micro-photography of metal specimens fulfils the higher demands of the subject. See our special Prospectus (M. 59) relating to this apparatus.

D. Specifications for Binocular and Monocular image-erecting Microscopes.

Specification 17.

Binocular Microscopes.

Paired Objectives:

(55)	(a0)	(a2)	(a3)	(Pl)			*Codeword*
45.—	45.—	45.—	45.—	55.—	. . . . .	Mk. 235.—	

Paired Oculars:

2, 3, 4	„ 36.—			
Glass Cell for Plankton-searcher No. 2030 . . .	„ 3.50	Mk. 274.50		
Outfit completed by adding:				
a) **Stand X^a** No. 95	„ 195.—			
Prism Rotator No. 197	„ 75.—			
Capillary Rotator No. 198	„ 50.—			
Packing	„ 3.—	„ 323.—	Mk. 597.50	**Pluratives**
or				
b) **Stand X^b** No. 96	„ 260.—			
Dissecting Stand No. 9605	„ 40.—			
Packing	„ 4.50	„ 304.50	„ 579.—	**Plusculos**

Specification 18.

Binocular Microscopes, somewhat cheaper.

Paired Objectives:

(a0)	(a2)		
45.—	45.—	Mk. 90.—	

Paired Oculars:

2, 4	„ 24.—	Mk. 114.—		
Outfit completed by adding:				
a) **Stand X^a** No. 95	„ 195.—			
Packing	„ 2.50	„ 197.50	Mk. 311.50	**Podasimus**
or				
b) **Stand X^b** No. 96	„ 260.—			
Packing	„ 3.—	„ 263.—	„ 377.—	**Podismavit**

Carl Zeiss, Jena.

Specification 19.

Corneal Microscopes (see p. 65.)

Paired Objectives:

(55) (a0)

45.— 45.— . . . . . Mk. 90.— *Codeword*

Paired Oculars:

2, 4 . . . . . „ 24.— Mk. 114.—

Outfit completed by adding:

a) **Stand Xe** No. 98 . . . . . „ 220.—

Packing „ 3.50 „ 223.50 Mk. **337.50** **Podredura**

or

b) **Stand Xe** No. 9810 . . . . . „ 250.—

Sole-plate with Chin-rest, No. 9820 . „ 45.—

Packing „ 5.— „ 300.— „ **414.—** **Poetabor**

Specification 20.

Monocular, image-erecting Microscopes specially adapted for dissecting.

Stand XI No. 9905 . . . . . Mk. 140.—

Outfit completed by adding:

a) **Achromatic Objectives:**

55 mm **a3** **a*** **A** **C**

15.— 12.— 40.— 20.— 30.— . . Mk. 117.—

HUYGENIAN **Oculars:**

2, 4 . . . . . „ 12.— „ 129.—

Revolving Nose-piece for 3 Objectives,

No. 49 . . . . . „ 20.—

Packing „ 2.— „ 22.— Mk. **291.—** **Poetassimo**

or

b) **Achromatic Objectives:**

a0 (in spec. mount) **a3**

12.— 12.— . . . . . „ 24.—

HUYGENIAN **Oculars:**

2, 4 . . . . . „ 12.—

Packing „ 1.50 „ 37.50 „ **117.50** **Poeteresti**

Specification 21.

Combined new Drawing Apparatus for low magnifications and Dissecting Stand for large objects.

Stand P II No. 103 (see details on p. 67) . . . Mk. 410.—

Packing „ 5.50 Mk. **415.50** **Paticojo**

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